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DESCRIPTIONS OF NEW MYMARID EGG PARASITES FROM HAITI AND PUERTO RICO

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Only a few Mymarids have been recorded to date for the West Indies. The present paper describes twelve new species and gives some rearing records from definite hosts.

Altho but one species, *Alaptus borinquensis*, herein included is described from Puerto Rican material, all of them are quite likely to be found in Puerto Rico when the proper rearings can be made. This is especially true of *Anagrus empoascae*, parasitic on *Empoasca fabalis* De Long, the common and injurious leafhopper of beans in Puerto Rico. The determination of *Anagrus flaveolus* Waterhouse, as a parasite of the sugar cane hopper, *Saccharosydne saccharivora* Westw. is of importance since the previous determinations of this parasite as *A. armatus* Ashm. in both Puerto Rico and Haiti are undoubtedly in error.

Due to the extreme difficulty of determining these minute insects except with type material for direct comparison, the types of the new species in this paper are retained for the present in the writer's collection, eventually to be deposited in the U. S. National Museum collection.

Gonatocerus quadrivittatus, new species.

The yellowish color of the female abdomen, marked with four more or less distinct brown cross bands readily differentiates the species.

Female.—Length, including ovipositor, 0.817 mm.; expanse 1.59 mm.; greatest width of forewing 0.237 mm. General color of the head and thorax black, the abdomen dirty yellowish with four more or less distinct cross bands or vittae of brown, the anterior two bands being very narrow and interrupted at the middle; antennae dark brownish-gray, the scape and pedicel of a slightly lighter shade; thorax black marked on disk with two lateral yellowish bands covering a portion of the prescutum around the posterior and lateral margins, and carrying down onto the propodeum. Wings hyaline, the venation brown. Femora pale yellowish, the tibiae, the two distal joints of the tarsi and the first joint of the hind tarsi, brownish-gray.

Head slightly wider than the thorax. Antennae rather long, the scape nearly four times as long as the pedicel and slightly wider; 1st and 2nd funicle joints decidedly shorter than all other joints of the antennae; funicles 3 to 8 subequal in length but each successively increasing in width; club solid, almost equal in length to that of the last three funicle joints combined, about twice as wide as the last funicle joint. Thorax comparatively short and broad, longer than wide. Forewings rather broad, three times as long as greatest width; disk covered with short cilia; marginal cilia very short, the longest on the posterior margin, less than one-sixth as long as the greatest wing width. Abdomen rather slender, over twice as long as wide, the ovipositor short but distinctly exserted.

Male.—Length 0.69–0.817 mm. Differs from the female in coloration of the abdomen, the four brown bands being fused to make the lower two-thirds of abdomen brown in the male. The male varies in length but is generally slightly shorter than the female. The structure of the male antennae is very distinct and different and enables immediate separation from the female; 13-jointed, long and distinctly flattened, all joints except the scape and pedicel have prominent longitudinal sensoria or carinae, the number of these varying, usually from 7–9. The male antennae smoky with the exception of the scape and pedicel which are more yellowish; the funicle joints subequal in length and verying little in width; the first funicle is slightly wider and dilated a little; the last antennal joint is slightly shorter and narrower than the others, narrowing to a tip.

Described from three females and five males, reared by the writer from foliage and stem material of the Barbados Cherry, *Malphigia glabra*, at Port-au-Prince, Haiti, July 30–Aug. 10, 1931. This material was infested with an undescribed aleyrodid and a fulgorid hopper, *Ormenis* sp. A paratype male and female is deposited in the U. S. National Museum collection, No. 43880.

Gonatocerus flaviventris, new species.

Distinguished by its short, compact antennae with very broad club and the yellowish colored abdomen. Closest to *G. cubensis* but smaller.

Female.—Length, including the ovipositor, 0.530 mm.; expanse 1.186 mm.; greatest width of forewing 0.172 mm. General color of the head and thorax dark brown, lighter colored areas on the vertex and thorax; abdomen yellowish, somewhat darker or soiled on the distal third; antennae grayish-brown, the scape and pedicel a shade lighter in color, the scape the palest with the upper margin infuscated; wings hyaline, the venation brown; legs soiled testaceous-yellow, the tibiae and distal two joints of tarsi, brownish.

Antennae comparatively short and compact; the scape short, decidedly compressed, over twice as long as wide; pedicel one-half as long as the scape and slightly narrower; funicles 1–3 very short, subequal in length, about half as long as the pedicel; funicles 4–8 increasing slightly in length and width; club solid, very large, two and a half times as wide as the last funicle, and exactly equal in length to that of the last three funicle joints combined. Forewings not unusually broadened, two and a-half times as long as wide; the disk covered with short cilia; marginal cilia short, those of the posterior margin the longest, about

one-fourth as long as the greatest width of the wing. Abdomen petiolate but the petiole is very short and inconspicuous; the ovipositor barely exserted. Tarsi 5-jointed.

Male unknown.

Described from a single female reared by the writer from Lignum-vitae foliage infested with the Woolly Whitefly, *Aleurothrixus floccosus* (Maskell) at Sarthe, Haiti, March 5, 1931. It is very unlikely, however, that this species is a parasite of the aleyrodid.

Gonatocerus cubensis, new species,

Closest to *G. flaviventris* in coloration but readily distinguished by its lighter colored thorax, more slender antennae, and peculiar appearance of the tarsi.

Female.—Length, including ovipositor 0.602 mm.; expanse 1.31 mm.; greatest width of forewing 0.162 mm. Head dark brown; antennae light brown, the scape and pedicel slightly lighter; thorax a soiled yellowish, the anterior margin of the prescutum heavily infuscated, the entire disk of the thorax clouded with pale brown; the abdomen soiled yellowish, distinctly soiled or clouded on the distal two-thirds; wings hyaline, the venation gray; legs yellowish-testaceous, the hind tibiae slightly darker; all tarsal joints except the basal two of the front legs and the first of the intermediate and hind tarsi, darker, with a peculiar appearance of mixed reddish granular matter and dark setae.

Head about as wide as the thorax. Antennae long and rather slender; the scape slender, two and a-half times as long as the pedicel; pedicel slightly wider than the scape and the first five funicle joints; funicles 1–3 extremely short, only one-half as long as the pedicel. The third very slightly longer than the first two; funicles 4–8 nearly equal in length but widening greatly; club solid, nearly twice as wide as the last funicle and not quite as long as the length of the last three funicle joints combined. Forewings long, widened somewhat spatulate, greatest width only about one-third the length; disk covered with numerous cilia; longest marginal cilia only about one-fifth as long as the greatest width of wing. Ovipositor scarcely exserted. Tarsi 5-jointed.

Described from a single female reared by the writer at Port-au-Prince, Haiti, July 27, 1931, from a shipment of citrus foliage infested with *Aleurocanthus woglumi* Ashby and parasitized with *Eretmocerus serius* Silvestri, received from Dr. C. P. Clausen, collected near Havana, Cuba.

Polynema vittatipennis, new species.

A very large, distinct species with twice-banded wings, closely allied to *P. bifasciatipenne* (Gir.) but is less slender, decidedly smaller, lacks the basal band across the forewing that is present in that species, and the ovipositor appears to be slightly more exserted.

Female.—Length, including ovipositor, 1.348 mm.; expanse 1.95 mm.; greatest width of forewing 0.186 mm. Color of the head, thorax and abdomen dark

brown, the petiole pale yellowish; antennae brown with exception of the yellowish scape and pedicel, the 1st funicle joint a shade lighter than the other funicles and the club. Forewings hyaline, banded near the middle and towards the tip with brown; the apical vitta crosses the forewing at its widest portion and does not quite reach the anterior and posterior wing margins; marginal vein light brown. Legs pale except the femora, distal two-thirds of the hind tibiae, and the last tarsal joints, brown; the front and middle femora have the tips lightened. The extruded ovipositor pale, darkening towards the tip.

Head slightly wider than the thorax. Scape short and stout, subequal in width to the pedicel and a third longer; funicle joints long and narrow, each widening slightly to their distal tips and increasing a little in length; 1st funicle joint narrow, subequal to pedicel in length; 2nd funicle is the longest antennal joint, twice as long as the 1st funicle and a fourth longer than the third; fifth and sixth joints subequal in length and barely longer than the fourth; club solid, very large and wide, nearly four times as wide as the last funicle and slightly longer than the last two combined. Forewings rather narrow, starting slender, enlarge gradually and reach their greatest width shortly before the narrowed but rounded tip; provided with distinct, dark, longitudinally placed, cilia except for the usual naked basal portion, and less numerous middle transparent portion; marginal cilia of moderate length, longest along the posterior margin towards apex; a very narrow clear path follows the base of the marginal cilia around the apex of the forewing. Hind wings extremely narrow, lineate, inconspicuous. Abdomen compressed, narrowed to tip; the sheaths of the ovipositor greatly exserted beyond the abdomen, the ovipositor issuing beneath, originating near the base of the abdomen; the petiole subequal to the hind trochanters in length. Legs long and slender. Tarsi 4-jointed, the proximal joint of the hind tarsi longer than the other joints combined.

Described from two females reared by the writer from sweet potato foliage, infested with several species of leafhoppers, the large Delphacid *Copicerus irroratus* Swz. and several small crickets of the tribe Trigoniniidae from whose eggs the species possibly issued, Port-au-Prince, Haiti, December 30, 1929.

Paratype deposited in the U. S. National Museum collection No. 43877.

The nearest related species, *Polynema bifasciatipenne* (Gir.) was described as a parasite of the eggs of the very small green cricket, *Anazipha exigua.* The U. S. National Museum has numerous specimens from Canada, New York, Kansas, Delaware, and Texas, some of them reared from eggs of the Snowy Tree-Cricket, *Oecanthus niveus.*

Polynema phaseoli, new species.

Very close to *P. eutettixi* Gir and *consobrinus* Gir. in coloration and structure but, after comparison with the types, is separated from those species at once by having both the 3rd and fourth tarsal joints distinctly brown.

Female.—Length, including ovipositor, 0.918 mm.; expanse 1.52 mm.; greatest width of forewing 0.172 mm. General coloration black, the petiole paler; antennal joints all brown except the pedicel which is pale, the anterior marginal portion slightly clouded with fuscous; legs dark brown except the proximal and distal tips of the femora and the first tarsal joints which are yellowish; hind coxae slightly less brown than the others; the 2nd and 3rd tarsal joints grayish, the 4th distinctly black.

Scape short, dilated; pedicel short, subequal in width to the scape at its greatest dilation; first funicle narrow, nearly as long as the pedicel; second funicle decidedly longer than the others, over twice as long as the first; third funicle nearly two-thirds as long as the second; the fourth and fifth subequal in width and length, the sixth distinctly wider and longer; club solid, longer than the last two funicle joints combined. Forewings rather long and slender, slightly narrower than those of *P. haitiana;* hyaline, discal cilia numerous and comparatively short; the longest marginal cilia nearly two-thirds as long as the greatest width of the forewing. Petiole less than one-third as long as the abdomen; abdomen compressed, elongate, the ovipositor distinctly exserted, but short (exserted 3 mm.). Tarsi 4-jointed, the hind tarsi with the proximal joint nearly equal in length to the second and third joints.

Described from two females reared by the writer from red bean foliage at Damien, Haiti, March 3, 1931. The membracid, *Stictocephala sp.,* occurs occasionally on beans in Haiti and its eggs may have been present and the host of this parasite.

Paratype deposited in the U. S. National Museum No. 43878.

Polynema haitiana, new species.

Structurally quite similar to *P. phaseoli* but slightly longer and easily separated by its yellowish-orange legs.

Female.—Length, including ovipositor, 1.06 mm.; expanses 1.84 mm.; greatest width of forewing 0.207 mm. General color black, the petiole and legs yellowish-orange; antennae dark brown except the scape and pedicel which have their dorsal margins slightly infuscated; front tarsi with the proximal joint slightly soiled grayish, the 2nd and 3rd distinctly gray and the last black; the intermediate and hind tarsi with the proximal joint yellowish, the 2nd and 3rd grayish, and the last black.

Head about as wide as the thorax. Scape short, distinctly dilated slightly wider than the large pedicel; first funicle joint short, about two-thirds as long as the pedicel; the second funicle distinctly the longest funicle, two and a-half times as long as the first; third funicle subequal in width to the second but shorter, only two-thirds as long; fourth, fifth, and sixth successively increase in length and width; the club solid, large and prominent, very wide its greatest width being three times that of the last funicle; longitudinal clear sensoria are visible on the last funicle and club. Forewings hyaline, rather slender, the longest marginal cilia only about one-half as long as the greatest width of the wing; the discal cilia numerous, comparatively short. Petiole long, nearly one-fourth the length of the long, rather slender abdomen, the ovipositor distinctly exserted. Tarsi 4-jointed, the first joint nearly as long as the others combined.

Described from a single female taken by the writer while sweeping grass and weeds between coffee and bananas at Fond-des-Negres, Haiti, June 12, 1930.

Anagrus flaveolus Waterhouse.

1913 Bul. Ent. Res., vol. 4, pt 1, May.

A single female reared by the writer from the eggs of the Corn Leafhopper, *Peregrinus maidis* (Ashm.) at Damien, Haiti, Jan. 25, 1930 undoubtedly represents typical *flaveolus*, a species originally described from specimens reared by P. L. Guppy in Trinidad from the eggs of the same host. In the U. S. National Museum are five females reared by P. L. Guppy at St. Joseph, Trinidad, Oct. 17, 1911 from *Peregrinus maidis* eggs and evidently represent a portion of the original rearing that was studied by Waterhouse. These specimens have been carefully studied and have funicle joint 1 distinctly longer than the other funicles and the scape under high magnification shows the dorsal margin distinctly serrated which appears to be very characteristic of this species; numerous minute transverse lines or segmentation is present on the scape.

A series of six males and fourteen females reared by the writer from eggs of *Saccharosydne saccharivora* on sugar cane at Port-au-Prince, Haiti, Aug. 7–9, 1930, were at first determined as *armatus* (Ashm.) but do not agree with North American material of that species, having funicle joint 3 only subequal to 4 and not longer than the fourth as is true of the type of *armatus*. In this series the serrated margin of the scape, so characteristic of all the known *flaveolus* material reared from *Peregrinus maidis,* is only indistinctly present in some of the series. The species of *Anagrus* attacking the eggs of the West Indian Sugar Cane Delphacid may prove to be distinct from *flaveolus* when further material is studied. The body and legs of both sexes of the Haitian material reared from *Saccharosydne saccharivora* eggs were of a distinct orange color with the mesonotum infuscated when living but faded to pale yellowish upon being mounted on slides in balsam.

Anagrus empoascae, new species.

In coloration very like the American *A. armatus* var. *nigriceps* Gir. but most easily separated from that species by its much shorter and stouter antennae with the second funicle joint short, subequal or shorter than the third. In structural characteristics, this species comes closest to *A. epos* Gir. but a large reared series of that species shows it to be distinct and separated at once by *empoascae* having

the distal funicle usually only subequal in length to the second joint and not distinctly longer as is the case with *epos*.

Female.—Length, including ovipositor, 0.387 mm.; expanse 0.875 mm.; greatest width of forewing 0.050 mm. In life the general coloration is distinctly yellowish (not orange in any degree as contrasted with the species of *Anagrus*, reared from eggs of *Saccharosydne saccharivora* and determined as *A. flaveolus* Waterhouse), the head, anterior portion of the prescutum, and the abdomen fuscous; in some specimens only the basal and apical portions of the abdomen are infuscated; antennae gray except the scape, pedicel and first funicle joint which are pale yellowish; legs entirely pale yellowish; when living specimens of this parasite are mounted directly into xylol balsam, the latter is stained yellowish the specimens clearing up distinctly yellowish.

Head subequal in width to thorax. Antennae somewhat similar to *flaveolus* but the funicle joints are rather stout; scape about twice as long as the pedicel, slightly broader than the scape of *A. flaveolus* with the segmentation or transverse lines less distinct and the dorsal border is not serrated as in that species; funicle 1 very short; funicle 2 varying somewhat in length but subequal or slightly shorter than the 3rd and subequal only to the distal joint in length and not decidedly shorter as is the case with *epos* Gir.; all funicles except the first are subequal in length, successively widening. Forewings slightly wider than those of *flaveolus;* the discal ciliation very variable with the number of irregular rows or lines of cilia varying from 4 to 6 partial rows but a more or less distinct naked area is left near the caudal wing margin proximad of the apex which is characteristic of this species. Abdomen at base nearly as wide as the thorax, gradually narrowed to tip, the ovipositor distinctly exserted. Tarsi 4-jointed.

Male unknown.

Described from a series of twenty-nine females mounted in balsam; reared by the writer from eggs of the Bean Leafhopper, *Empoasca fabalis* DeLong, on red bean foliage at Damien, Haiti, Jan. 20–22, 1930; one slide containing four females reared by the writer from bean foliage at Damien, Feb. 26, 1931. Paratype slide containing eight females deposited in the U. S. National Museum No. 43876.

The host of this egg-parasite was described by Dr. DeLong (Canadian Entomologist, vol. 62, p. 92, 1930) and is known from Haiti and Porto Rico. This leafhopper was proved by the work of Smith & Barker in Haiti to be the transmittor of the Bean Yellows disease, the most serious disease of the bean in the West Indies.

Anagrus noeli, new species.

The elongated thorax, arrangement of setae on the sides of the abdomen, short endophragma confined to the thorax, readily differentiates this species.

Male.—Length, exclusive of the oedeagus, 0.516 mm.; expanse 1.03 mm.; greatest width of forewing 0.078 mm. General color dark brown with the lower two-thirds of the prescutum and portion of the axillae, and nearly the basal half

of the abdomen yellowish-orange; oedeagus and antennae pale grayish; hind legs light brown, the front and middle legs distinctly paler.

Antennae 13-jointed, the scape and pedicel subequal in length and width, about half as long as the funicle joints which are all subequal in length and width. Thorax very elongate, slightly longer than the abdomen; prescutum and axillae with a strong seta present; endophragma present but does not extend into the abdomen as is the case with *A. empoascae.* Forewings rather broad for typical *Anagrus,* with prominent fringe of marginal cilia, the longest of which is nearly twice as long as the greatest width of the wing; marginal vein with four setae, the two proximal ones placed very close together; the outer third of the wing is thickly covered with discal cilia; a small but distinct seta is present in the bare area below the marginal vein. The abdomen elongate with the lateral margins running almost parallel for three-fourths the length and then rounding to the tip; oedeagus distinctly exserted and prominent; along each side of the abdomen is a double row of widely separated strong setae, numbering 5–6 setae in the row, the outer row following along the lateral margin. Tarsi 4-jointed.

Described from a single male collected by the writer on leaf of the Sea-grape, *Coccoloba uvifera,* at Port-au-Prince, Haiti, May 26, 1930. The species is named in honor of Mr. Alphonse Noel who rendered the writer valuable assistance in rearing many parasitic hymenoptera as Assistant Entomologist of the Service Technique, Haiti.

Anaphes bicolor, new species.

A very small, distinctly colored species, with flagellum and legs pale.

Female.—Length, including ovipositor 0.416 mm.; expanse 0.89 mm.; greatest width of forewing 0.086 mm. General color dark brown, the basal half of the abdomen yellowish, the distal half black; antennae pale yellowish, except the brown club; legs pale yellowish except the terminal joint of the tarsi. Head short and deep. Scape rather short and compressed, only twice as long as the wide pedicel; first funicle joint very short and narrow, the second slightly longer, subequal in width; third funicle conspicuously the longest and widest joint of the funicle, about twice as long as the second; funicles 4–6 very short, about equal in length to the second but distinctly swollen, the fifth and sixth appearing somewhat globose; club appearing under high magnification almost as if having a division, almost as long as the last four funicle joints combined, distinctly wider than the other joints. Thorax longer than the abdomen. Forewings nearly four times as long as the greatest width; distal two-thirds of forewings covered with numerous short cilia; longest marginal cilia are along the outer posterior margin, equal in length to the greatest width of the blade. Femora wide and distinctly flattened. Abdomen slender, ovipositor distinctly exserted. Tarsi 5-jointed.

Described from two females mounted in balsam on two slides; reared by the writer from red bean foliage infested with the Bean Leafhopper, *Empoasca fabalis* DeLong, at Damien, Haiti, Jan. 21–22, 1930.

Camptoptera minutissima, new species.

This is the smallest known member of the genus. Distinguished by its minute size and extremely short pale first funicle joint.

Female.—Length 0.215 mm. General color light grayish-brown, the basal third of the abdomen distinctly paler. Antennae uniformly pale gray, the pedicel only slightly lighter in shade. Eyes black. Ocelli reddish. Wings hyaline or barely perceptibly smoky. Legs pale yellowish.

Vertexal carina present. Thorax distinctly wider than the abdomen and about one and a-half times as long. Under high magnification, the vertex and prescutum appear horizontally or cross-wise finely lineate, the scutellum longitudinally lineate; petiole short, not barbed as in *C. pulla* Gir., the thorax on its hind margin is produced into two short barb-like projections at the middle on each side of the petiole; abdomen broad at its base, narrowing on each side somewhat triangular shaped to point formed by the barely exserted ovipositor. Antennae elbowed, long and slender, almost as long as the body, nine-jointed with an additional very minute ring-joint following the first funicle; scape rather short, only slightly longer than the pedicel; pedicel very large and wide; first funicle extremely short in comparison with other known species of the genus, about one-fourth as long as the pedicel and only one-fifth as long as the second true funicle joint; a very minute but clearly distinct ring-joint is visible under high magnification between the first and second true funicle joints; third funicle nearly a third shorter than the second; fourth, fifth and sixth subequal in length but increasing slightly in width; club solid, long, subcylindrical ovate, slightly longer than the last three funicle joints combined; the funicle and club joints are provided with numerous minute setae; the club, in the single specimen, appears to have a distinct longitudinal crease or fold. Forewings typical of the genus, longer than the body, slender, with a distinct dilation along the caudal margin at proximal fourth, curved or bowed at the apical half; with complete fringe of long cilia, the usual clear path around the margins of the wing; a double longitudinal row of minute setae follow around the margins of the wing and on the disk near the apex are two distinct setae; anterior margin of the wing is slightly darker and more distinctly outlined; hind wings linear, slightly curved at about the middle. Legs normal, with five subequal tarsal joints.

Described from a single female, reared by the writer from avocado foliage infested with *Empoasca minuenda* Ball at Petionville, Haiti, Dec. 16, 1930.

Alaptus minutus, new species.

This is the second smallest recorded North American species for the genus *Alaptus,* measuring only 0.215 mm. The smallest *globosicornis* Gir. measures only 0.199 in the female sex. In male antennal characters this species is closest to *eriococci* Gir. but differs greatly in both coloration and size.

Male.—Length 0.215 mm.; expanse 0.588 mm.; greatest width of forewing 0.022 mm. Very minute. General color of head and abdomen pale brown, the thorax especially across the middle distinctly paler; ocelli red; antennae with

whitish scape and pedicel, the funicle joints 1–3 pale brown, 4–8 distinctly brownish; the legs pale.

Antennae 10-jointed, long and slender, the scape narrowest at base, somewhat compressed, one and a-half times as long as the pedicel; pedicel subconic, wider than the scape; first funicle joint the shortest, funicles 2 and 3 subequal but only about two-thirds as long as the remaining joints which are subequal in length and increasing perceptibly in width; the scape with three setae along the lower margin and one near the upper margin; the pedicel with three setae. Vertexal carina present. Eyes naked or without hairs. Thorax without setae except for an extremely long one on the axilla; prescutum under high magnification appearing minutetly and transversely rugulose or lineate; endophragma present extending back one-half the length of the abdomen. Wings normal for the genus, long and narrow with the remarkable dilatation near the base of the forewings, terminating in a conspicuous excised notch; the remainder of the wing with fringe of long cilia; a median line of discal cilia present, the number of cilia evidently variable, one wing showing seven and the other ten.

Female unknown.

Described from a single male specimen reared by the writer from lime foliage, infested with *Parlatoria zizyphus* scale, etc., at Port-au-Prince, Haiti, June 18, 1931. Most probably from the eggs of a psocid as the other definitely known hosts of members of this genus are for the most part parasites of psocid eggs.

Alaptus borinquensis, new species.
A very variable species in size.

Female.—Length, including ovipositor 0.186–0.344 mm.; expanse 0.745 mm.; greatest width of forewing 0.029 mm. General color dark brown, the antennae and legs light brown, the pedicel slightly paler.

Antennae 8-jointed, the scape and pedicel very stout and compressed, the latter a third shorter than the scape and slightly wider; first two funicles very narrow, only one-third as wide as the pedicel, the second about one-third longer than the first; the remaining funicles successively enlarging, 3 and 4 subequal in length, 5 somewhat shorter; club solid, very large, nearly twice as wide as the last three funicle joints combined. Prescutum under high magnification with somewhat obliquely arranged lineations, provided on each side with a strong seta; axilla with a short seta. Forewings shaped somewhat as in members of the genus *Dicopus* with a very prominent wide transparent path around the base of the marginal cilia; from 13–15 discal cilia present, characteristically placed in this species in a line just inside the anterior margin of the forewing, following the contour. Endophragma present. Abdomen slightly longer than the thorax, the ovipositor prominent and distinctly exserted.

Male. Length 0.243 mm. Similar to the female except the 10-jointed, filiform antennae; the coloration of the legs and antennae appear paler. Scape and pedicel stout, about same as those of the female; the funicle joints 1–3 very narrow, the first being about a third shorter; funicles 4–7 subequal in length and width, distinctly wider than the other funicles; the special joint or

club is a third shorter than the preceding joint, distinctly narrower, narrowed to somewhat pointed tip.

Described from four females and two males reared by the writer from *Asterolecanium pustulans* scale material on *Cassia fistula* at Rio Piedras, Porto Rico, May 14–19, 1925. A paratype female is deposited in the U. S. National Museum collection No. 43879.

NOTES ON THE GENUS *ANERISTUS* HOWARD WITH DESCRIPTIONS OF NEW SPECIES

(Hymenoptera: Chalcidoidea)

By HERBERT L. DOZIER
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The purpose of this paper is to establish as clearly as possible the status of the genus *Aneristus* Howard, to assemble all the available information concerning the habits and host-relationships of its members, and to make known three new species from the West Indies. So far as known all the species of *Aneristus* are primary parasites of the non-diaspine Coccidae or soft scale insects and are of great economic importance.

Aneristus ceroplastae How. is one of the most important enemies of soft scales in the West Indies and is widely distributed throughout the tropics. It does not confine its attack to any one species but is recorded as having been reared from at least six different genera. *Aneristus youngi* Girault has been reared from two different genera in Louisiana. *A. mangiferae* Dozier and *asterolecanii* Dozier appear to confine their attack principally to the Mango Soft Scale, *Coccus mangiferae* (Green), and the Golden Asterolecanium, *A. aureum* Boisd., respectively, and are known only from the West Indies.

Compere in his recent "Revision of the species of Coccophagus"[1] points out that the genus *Coccophagus* is imperfectly defined and that the characters used to separate this from *Aneristus, Prospaltella* and certain other allied genera are relative and cannot be sharply defined. The few species of *Aneristus* described to date have been distinguished from those of *Coccophagus* by having a row of short stiff bristles behind on the flattened posterior tibiae, and a distinctly compressed funicle. In true *Coccophagus* the hind tibia is normal with the row of distinct bristles lacking, and the flagellum is fusiformly subcylindrical, the funicle joints usually plainly longer than wide. In addition all recorded species of *Aneristus* where both sexes are known, have the forewing of the female hyaline with a distinct infumation on the discal portion while the male forewing is entirely hyaline.

In 1915 Silvestri erected the genus *Prococcophagus,* based on the

[1] Proc. U. S. National Museum, vol. 78, art. 7, pp. 1–132, pls. 1–14, 1930.

female sex of the new species, *Prococcophagus varius* Silv.[2], stating that the new genus could be separated from *Coccophagus* by the differences in the head, dorsum, greater length, by having the antennae inserted a short distance from the clypeal margin, and by the large compressed scape. The two new species described in this paper as *A. hispaniolae* and *asterolecanii* clearly fall into *Prococcophagus* but grade into *Aneristus* if the concept of that genus be broadened to include those species with the scape much flattened or foliaceous. In the writer's opinion *Prococcophagus* must fall as a synonym of *Aneristus* which, however, seems sufficiently distinct from *Coccophagus* to be retained. The last-mentioned genus seems very closely connected to *Aneristus* by such species as *Coccophagus modestus* Silv., *bivittatus* Compere, and *argenteus* Gir. Compere states that the last species has unusual wings, unlike any other described *Coccophagus*.

Girault in 1917 (Ins. Insc. Menstruus, vol. 5, p. 37) synonymized his genus *Tanaeostigmoidella* with *Prococcophagus* Silv.

The following characterization of the genus *Aneristus* has been broadened to include those species with the scape dilated or foliaceous. In certain species such as *A. ceroplastae, croconotus, mangiferae,* and *oculatipennis* a conspicuous group of strong setae are present at the proximal end of the middle tibia; in others such as *hispaniolae* and *asterolecanii* these are lacking. A minute study of the chaetotaxy of all the species should be made when further material of certain species becomes available.

The genus *Aneristus* Howard

Aneristus Howard, The Canadian Entomologist, vol. 27, 1895.

Characterization.—Closest to *Coccophagus*. Antennae eight-joint, with a very minute ring-joint, barely discernible under high magnification, present in the female sex between the pedicel and first funicle joint; the scape is distinctly compressed and in certain species is more or less foliaceous; a longitudinal carina is usually present on the scape, dividing the inner portion which regularly forms the scape from an outer more foliaceous extension; the club well-defined, distinctly three-jointed; very characteristic longitudinal elevations or sensoria are present on the club and the funicle joints, although sometimes lacking on the first funicle; these sensoria are particularly prominent in the male. Eyes setose. Forewings with the marginal vein longer than the submarginal, a fuscous cloud generally present with the female but lacking in the male. Hind tibiae flat, with a row of short, stiff bristles behind; the hind femora somewhat thickened; middle tibial spur long and slender, almost as long as the first tarsal joint; all tarsi five-jointed. Internal parasites of the Soft or non-diaspine Coccidae.

Genotype.—*Aneristus ceroplastae* Howard.

[2] Descrizione di nuove Imenotteri Chalcididi africani, Bol. Lab. Zool. Portici, vol. IX, pp. 359–360, 1915.

Key to females of *Aneristus*.

1. Scape distinctly widened or foliaceous 6
   Scape not unusually widened 2
2. Dominant color dark, submetallic, the prescutum concolorous 8
   Dominant color lighter, the prescutum marked with yellow 3
3. Prescutum with lemon-yellow blotch; forewings with large infumed area extending completely across the wing. Africa ..... *croconotus* Waterston
   Prescutum with a wide yellowish band across the middle; forewing with a very narrow infumed area, not reaching across the wing. Haiti, Santo Domingo and Cuba ..... *mangiferae* new species
   Prescutum with a yellowish-white band; forewing with a three-fourths complete circular infumed ring. Peru and Panama ..... *oculatipennis* Girault
6. Third funicle joint brown, the upper third white. Haiti ..... *asterolecanii* new species
   Third funicle joint entirely whitish 7
7. Forewings with a wide hairless or bare area running longitudinally along the lower margin from the base to one-half the length of the forewing. Haiti ..... *hispaniolae* new species
   Forewings without this hairless area. Africa ..... *varius* Silvestri
8. Black without distinct purplish reflections, the coxae pale; head more or less and the scape yellowish. Louisiana ..... *youngi* Girault
   Black, with purplish reflections, scape pale, the head and coxae black. Widely distributed in the tropics ..... *ceroplastae* Howard
   Wholly dark metallic purple, the legs and antennae dark except most of the first tibiae, distal half of the middle tibiae, and the tarsi, which are yellowish-white; proximal half of the middle tibiae black; forewings with a large infumed area, its proximal margin obliquely truncate from about the proximal third or more of the marginal vein. Australia ..... *fumosipennis* Girault & Dodd
   Wholly dark metallic purple, the legs and antennae dark except the scape and cephalic knees and tibiae which are white and all middle tibiae except slightly just distad of the knee; infumed spot on forewings shorter, its proximal margin straight. Australia ..... *diabolicus* Girault

The writer has not seen specimens of *A. croconotus* Waterston, *fumosipennis* Girault & Dodd, *varius* Silvestri, and *diabolicus* Girault and these species are included in the above key based on characters included in the original descriptions. To date the males of only three species are known, namely, *ceroplastae* Howard, *croconotus* Waterston, and *asterolecanii* Dozier.

Aneristus mangiferae, new species.

Closest in coloration to *A. croconotus* Waterston but has the infumed area of the forewings decidedly narrower than in that species.

Female. Length 1.02 mm.; expanse 1.72 mm.; greatest width of forewing 0.301 mm. General color of head and thorax yellowish-orange, the pronotum, scutellum, axillae, lower part of the scapulae, and the abdomen submetallic dark brown to black; a prominent yellowish band runs across the prescutum and upper portion of the scapulae, the anterior and posterior margins of the prescutum narrowly fuscous. Eyes dark. Ocelli red. Antennae with the scape pale yellowish,

the pedicel darker, and marked on upper margin with fuscous; the funicle and club joints smoky. Legs dirty yellowish to slightly smoky, except the slightly paler tarsi, and the dark brown hind femora and tibiae; the terminal tarsal joints smoky. Forewings with the venation smoky, hyaline; a rather narrow smoky infumation runs downward on the disk extending two-thirds across the width of the wing; this cloud starts on its outer margin at the stigmal vein, soon broadening out on the disk; from the stigmal this cloud extends inward to nearly half the length of the marginal vein.

The antennal scape rather long, compressed but not unusually widened, the pedicel subtriangular; minute ring-joint present; the funicle and club distinctly compressed, with prominent longitudinal sensoria; the first funicle joint is the longest, twice as long as the pedicel and about a third longer than the second and third subequal funicle joints; the joints nearly subequal in width or only slightly widening to including the first club joint; the lateral margins of each joint somewhat rounded at the ends; this last condition is accentuated in the club joints, the last two being narrower successively to tip; the shape of the

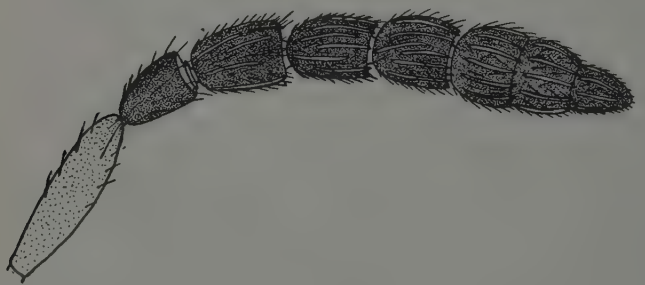

Figure 1.—Antenna of female *Aneristus Mangiferae*, new species, greatly enlarged.

club is rather distinctive in this species; all joints distinctly setose. The vertex, prescutum and scutellum are provided with numerous setae; axillae with a pair of setae; scutellum with a middle pair of small pores, a very strong pair of setae close to the posterior margin and a smaller pair placed anteriorly to these. The dark portions of the head, body and legs minutely reticulated in balsam-mounted specimens under high magnification. The middle femora supplied with a single prominent black seta near distal end, the middle tibia with a conspicuous group of five black setae at the proximal tip. Ovipositor barely exserted, visible in clear, balsam-mounted specimens, extending back to including the third tergite.

Male unknown.

Described from seven females mounted in balsam on slides, reared by the writer from *Coccus mangiferae* (Green) on mango foliage at Petionville, Haiti, Nov. 19–30, 1930; one female reared by Dr. Giuseppe Russo from *Saissetia hemisphaerica* (Targ.) at Moca, Republica Dominicana, March 9, 1928; and a single female reared by the writer in Haiti from Citrus material received from Cuba, during the course of *Eretmocerus serius* releases.

The type female from Haiti is deposited in the U. S. National Museum, Type No. 43807, together with the paratype females from the Dominican Republic and Cuba.

Aneristus ceroplastae Howard.

1895. Canadian Entomologist, vol. 27, p. 350.

1895. Proc. U. S. Nat. Museum, vol. 18, p. 633, *Coccophagus orientalis* How.

The original description was based only on the female sex, the male being described by the writer in 1927 (Jr. Dept. of Agr. of Porto Rico, vol. IX, no. 4, p. 366, 1925). At that time many rearing records from various hosts were given. In addition the writer has reared the species in Haiti in numbers from *Saissetia hemisphaerica* on weeds in coffee glade at Fond-des-Negres, March 3, 1930; from *Coccus mangifera* on mango at Petionville, Dec. 1, 1930; from *Coccus viridis on* "Cerisier marron", *Adelia ricinella,* at Petionville, Nov. 8, 1929; from *Ceroplastes dozieri* Cockl. on *Maytenus buxifolia* at Source Puante, Nov. 19, 1929; and from *Icerya* sp. on a wild bush known as "Ti buis" on Morne-a-Cabrits, Sept. 10, 1930.

Aneristus oculatipennis Girault.

1916. Psyche, vol. 23, p. 42.

The type and paratype card-pointed material from Peru in the U. S. National Museum has been studied together with the original slide containing head and wing, mounted in balsam. Two specimens reared by J. Zetek at Ancon, Canal Zone, Panama (Z 2594) in the U. S. National Museum, determined by Mr. A. B. Gahan, agree well with the type and extend the known distribution of the species.

Aneristus youngi Girault.

1917. Descr. Hym. Chalc. Var. cum Observ. V, p. 11.

The very brief description of this species appeared in a privately published paper and is given here to make it readily accessible.

"*Aneristus youngi.* Like *Coccophagus modestus* Silv. but legs black save hind coxae and first tibia, all tarsi; head more or less and scape yellow; scutellum hairy. From *Ceroplastes chrysanthemum* Baton Rouge, La., September, E. S. Tucker. Cat. No. 21477."

The type material, consisting of three card-pointed specimens, has been examined. These were reared from *Ceroplastes* sp. on chrysanthemum, evidently from either *C. cirripediformis* or *floridensis*, the only two species of *Ceroplastes* recorded from Louisiana. A specimen, reared by the writer from *Saissetia hemisphaerica* at New Orleans, La., Sept. 16, 1922 (Q–21511) and a specimen from *Coccus hesperi-*

dum on citrus at New Orleans, Jan. 15, 1926 agree exactly with the type. The last-mentioned specimen is mounted in balsam on a slide and a photomicrograph of its forewing is shown. The record of *A. ceroplastae* from Louisiana given by the writer in his paper on "An Outbreak of the Red-striped Sugar-Cane Scale" (Jour. Dept. Agr. of Porto Rico, vol IX, no. 4) was based on this specimen and is erroneous. *Aneristus youngi* Gir. can easily be distinguished from *ceroplastae* How. by its black color, lacking the distinct metallic purplish reflections of that species, by the pale coxae, by having the middle tibiae fuscous, and the infumed area of the forewing is distinctly narrower.

Aneristus hispaniolae, new species.

A large, well-marked and distinct species, easily recognized by its peculiar coloration and very foliaceous scape. In width of scape this species is closest to *Aneristus varius* Silv.

Female. Length .946 mm.; expanse 1.56 mm.; greatest width of forewing 0.237 mm. General color of the head and thorax orange, the ground color of

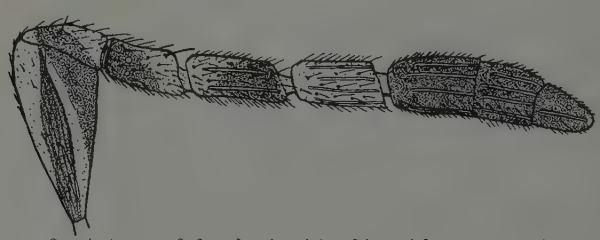

Figure 2.—Antenna of female *Aneristus hispaniolae,* new species, greatly enlarged.

the abdomen a pale yellowish-white with a broken band of black on each segment, leaving a pale colored median longitudinal area running from the dark brown endophragma to just before a line parallel with the vibrissal plates; under high magnification, the black areas appear more or less distinctly reticulated; legs pale testaceous, the proximal tips of the middle and hind tibiae and the terminal tarsal joints are very faintly marked with fuscous, scarcely noticeable. Ground color of antennae pale with the club brown; on the scape is a longitudinal stripe of brown along the middle and the outer widened part is distinctly infuscated; basal two-thirds of the first funicle joint and the lower half of the second are irregularly and somewhat obliquely infuscated. Eyes black.

Antennae eight-jointed, long. ventrally articulated, composed of scape, pedicel, a very minute ring-joint, three funicle joints and three-jointed club; the scape characteristically greatly widened or foliaceous, the inner part elongately reticulated; pedicel somewhat triangular, the funicle joints cut off obliquely on their inner half; all joints furnished with prominent setae; those joints forming

the club and the distal two funicle ones have longitudinal elevations or sensoria; the first funicle joint lacks these but is supplied near its base with two or three pale blister-like circular areas. Eyes setose. The head, thorax, and sides of the abdomen have numerous prominent dark setae. Forewings with a very short marginal fringe of cilia; the setae are very prominent and heavy, contrasting with a wide area running longitudinally along the lower margin from the base to one-half the length of the forewing and a wide area following the apical part of the wing, which appear to be bare or hairless areas on account of the transparent setae. Femora of middle legs with a long seta on posterior margin near the tip; all tarsi five-jointed. The brown ovipositor slightly exserted, visible for its entire length in balsam-mounted specimen, extending to the middle of the fourth tergite.

Male unknown.

Described from a single female, mounted in balsam on slide, reared by the writer from a giant wax scale, *Ceroplastes giganteus* Dozier, on branches of wild fig tree, *Ficus rubricosta* Warb. at Source Cazeau, Haiti, April 16, 1930.

The type slide is deposited in the U. S. National Museum, No. 43808.

Aneristus asterolecanii, new species.

Very closely related to *A. hispaniolae* Dozier, but the female is easily separated by its smaller size, less widened scape, and difference in coloration of the antennae.

Female. Length 0.803 mm.; expanse 1.28 mm.; greatest width of forewing 0.201 mm. General color a pale yellowish-white, marked with brown. The pronotum, disk of the axillae, and the lower margin of the scutellum, dark brown; the remainder of the thorax except the pale discal portions of the prescutum and scutellum, of a reddish-orange color; endophragma dark brown; under direct light, the pale portions of the prescutum, scapulae, scutellum, and the endophragma appear to reflect distinctly iridescent hyaline. Antennal ground color pale, the lower or posterior two-thirds of the pedicel, and of the three funicle joints brown; the club brown except the extreme tip which is pale; the scape pale except a comparatively narrow longitudinal brown strip along the middle. The eyes reflect hyaline. Abdomen of a pale yellowish-white ground color, the posterior half of each segment transversely banded with brown, the anterior one only partial, widely interrupted at the middle. Legs pale, the middle tibiae with two inconspicuous brown spots. The darkened areas of the body and the scape appear under high magnification more or less distinctly reticulated.

Antennae with the scape distinctly foliaceous, being intermediate in width between *A. hispaniolae* and *A. magniferae;* the pedicel slightly longer than wide, subtriangular; the first funicle joint slightly longer than the pedicel and about two-thirds the length of the second funicle, with two or three small blister-like inconspicuous areas present; third funicle slightly longer than the second and almost the same in width; club three-jointed, each joint successively shorter and narrowing to the blunt tip; prominent longitudinal sensoria present on the second and third funicle joints; a very minute ring-joint is present between the pedicel and the first funicle joint. The antennal joints are ventrally articulated. Eyes prominent, distinctly setose. The vertex, prescutum, and lower portion of the abdomen provided with numerous conspicuous setae; three setae are present on the axillae, the inner seta twice as long as the others; scutellum with posterior pair of setae decidedly stronger than the anterior pair and placed much farther apart; the propodeum with a pair of very long, prominent setae. Forewings very faintly infumed at the middle covering over half the wing area; the tip with hyaline area which extends along the posterior margin from the base outwards to a point nearly half the length of the marginal vein. Hind femora and tibiae compressed, the middle femora supplied with a prominent long seta on the posterior margin towards the tip. The ovipositor only very slightly exserted, extending to the fourth tergite.

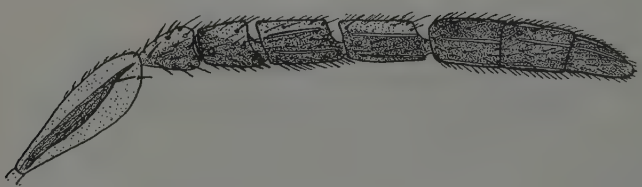

Figure 3.—Antenna of female *Aneristus asterolecanii,* new species, greatly enlarged

Male. Length 0.574–0.602 mm.; expanse 1.075–1.176 mm.; greatest width of forewing 0.172–0.186 mm. Resembles a *Coccophagus.* Varies considerably in size. Differs in coloration from that of the female, the vertex and thorax a dark yellowish-orange, the axillae dark. Antennae smoky brown, the basal third of the scape lightened. The propodeum and abdomen distinctly smoky brown. Legs pale, the hind tibiae slightly smoky. Forewings hyaline, lacking the infumation of the female.

Antennae distinctly flattened, ventrally articulated; the scape differing greatly from that of the female, being long and rather slender, only slightly compressed, longer than the pedicel and first funicle joint combined, the longitudinal recticulations faint; the longitudinal carina of the female scape is very indefinite or partial in the male; the minute ring-joint of the female antenna is lacking in the male; the first funicle joint distinctly longer and wider than the pedicel, and only perceptibly shorter than the second and third funicle joints; all joints narrowing successively to the tip of the club; the first club joint the longest; all funicle and club joints provided with prominent setae, and very distinct longitudinal sensoria. The entire area of the forewings are covered with distinct setae, the bare area of the female forewings being lacking.

Described from two females and seven males, mounted in balsam on slides, reared by the writer from *Asterolecanium aureum* (Boisd.) on wild *Annona* sp. on Morne-a-Cabrits, Haiti, May 22–June 1, 1931. The holotype female and allotype male are deposited in the U. S. National Museum, No. 43809.

In addition to the above-discussed members of the genus *Aneristus,* the following species have been described to date from various parts of the world:

Aneristus varius (Silvestri)
1915 Boll. Lab. Zool. Portici, vol. 9, p. 359, *Prococcophagus.*
Aneristus diabolicus Girault
1915 Mem. Queensland Museum, vol. 4, p. 65
Aneristus fumosipennis Girault & Dodd
1915 Mem. Queensland Museum, vol. 4, p. 64
Aneristus croconotus Waterston
1917 Bul. Ent. Research, vol. 7, pt 3, p. 234

Table of recorded species of *Aneristus* and their known hosts.

Name of the species	Known distribution	Hosts
Aneristus ceroplastae Howard	West Indies, Ceylon, Java and Hawaii	*Saissetia hemisphaerica* (Targ), *Coccus mangiferae* (Green), *Ceroplastes actiniformis* Green, *C. dozieri* Cockerell, *Pulvinaria iceryi* Guerin, *Coccus viridis* (Green), *Eucalymnatus tesselatus* (Signoret), *Saissetia nigra* (Nietn.), *Icerya* sp.
Aneristus asterolecanii Dozier	Haiti	*Asterolecanium aureum* Boisduval.
Aneristus youngi Girault	Louisiana	*Ceroplastes* sp., *Saissetia hemisphaerica* (Targ.), *Coccus hesperidum* Linn.
Aneristus hispaniolae Dozier	Haiti	*Ceroplastes giganteus* Dozier
Aneristus oculatipennis Girault	Peru and Panama	*Saissetia oleae* (Bernard).
Aneristus varius (Silvestri)	Eritrea, Africa	Unknown.
Aneristus croconotus Waterston	Gold Coast, Africa	*Lecanium* sp.
Aneristus mangiferae Dozier	Haiti, Santo Domingo, Cuba	*Coccus mangiferae* (Green), *Saissetia hemisphaerica* (Targ.)
Aneristus diabolicus Girault	Australia	Unknown.
Aneristus fumosipennis Girault & Dood	Australia	Unknown.

Explanation of Plates

The photomicrographs used in Plates I and II were secured from the U. S. Bureau of Entomology and are the work of the Bureau

photographer, Mr. J. G. Pratt, and the writer wishes to herewith express his appreciation.

PLATE XI

Forewing of female *Aneristus oculatipennis* Girault, paratype wing, U. S. National Museum Type No. 19211.

Forewing of female *Aneristus youngi* Girault, female reared from *Coccus hesperidum,* New Orleans, La.

Forewing of female *Aneristus ceroplastae* Howard, from paratype of *Coccophagus orientalis* Howard, U. S. National Museum Type No. 6905.

PLATE XII

Forewing of female *Aneristus mangiferae* Dozier, paratype female, U. S. National Museum Type No. 43807.

Forewing of female *Aneristus hispaniolae* Dozier, type female, U. S. National Museum Type No. 43808.

Forewing of female *Aneristus asterolecanii* Dozier, paratype female, U. S. National Museum Type No. 43809.

PLATE XI

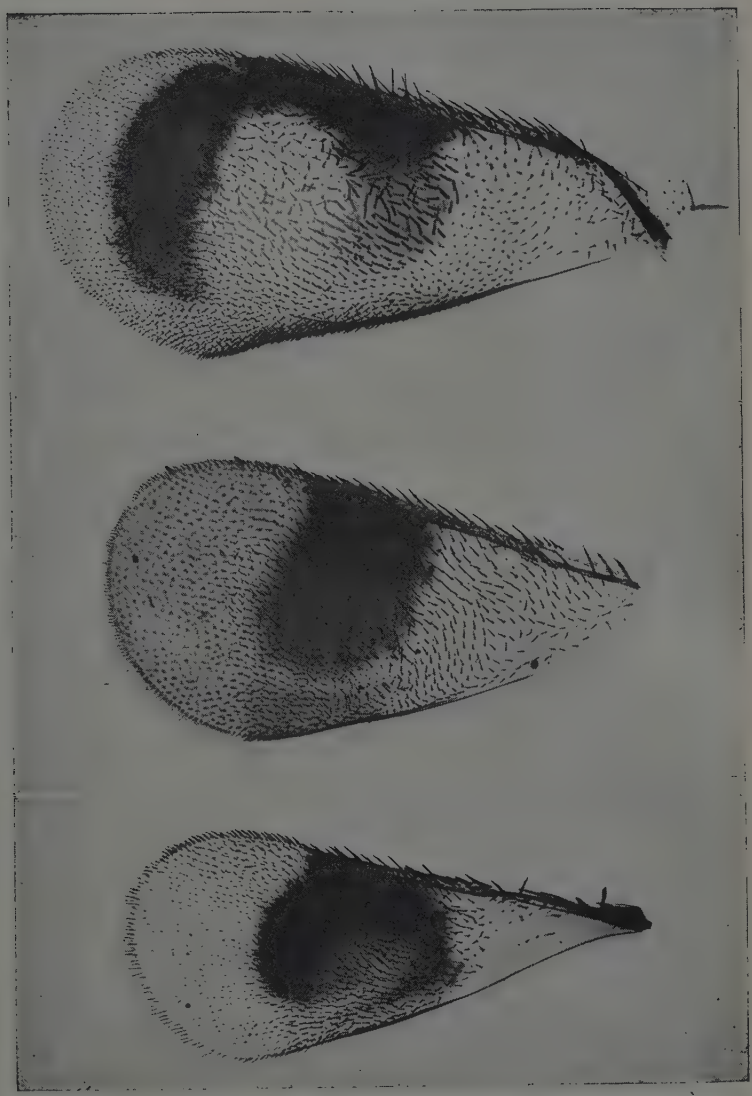

PLATE XII

TWO IMPORTANT WEST INDIAN SEED-INFESTING CHALCID WASPS

By Herbert L. Dozier
Formerly Chief Entomologist, Insular Experiment Station, Río Piedras, P. R.

The following brief and incomplete notes are presented here in order to call attention to two seed-infesting chalcid wasps in the hope that they will be studied further by other workers as the opportunity occurs. Both are of much economic importance but the damage occasioned by them has heretofore been completely overlooked. Although our knowledge of the distribution of these species is extremely limited, they undoubtedly will prove to be present on most of the islands of the West Indies and, possibly, wherever their host plants occur.

The writer wishes to express his thanks to Mr. A. B. Gahan of the U. S. National Museum for his kind assistance in placing these species generically.

THE LOGWOOD OR CAMPECHE SEED CHALCID

In 1890, Dr. L. O. Howard erected the genus *Tanaostigma* to include a single species, *T. coursetiae* Howard, from the ovaries of a rare leguminous tree, *Coursetia ? mexicana* Watson, in Mexico. In commenting on this unusual and supposedly phytophagous *encyrtid* he states that "We must leave it for future field observations upon this or upon some congeneric species to definitely settle this most interesting point". It is therefore exceedingly interesting to present, after a lapse of 42 years, a second species of the genus with conclusive proof of its phytophagous habits.

Dr. Giuseppe Russo has rather recently (Bol. Lab. Zool. Portici, vol. xxiv, pp. 132–139, 1930) described the new genus *Cubaniella* based on the single species *Cubaniella trotteri* Russo, from galls of *Belaira mucronata* Gris, collected at Santiago de las Vegas, Cuba, by Dr. S. C. Gruner. He places his genus in the subfamily Perilampinae Howard. His material represents a genus undoubtedly very close to *Tanaostigma* Howard, placed by Dr. Ashmead in a distinct tribe Tanaostigmini of the subfamily Eupelminae. Members of this tribe show certain relationships with both the Perilampinae and the Eurytominae as well as with the Eupelminae and it is a mooted question as to where they properly belong. The description of the Cuban

species, unfortunately, is based only on the female but is sufficient to show its close relationship with the new species from the seeds of logwood.

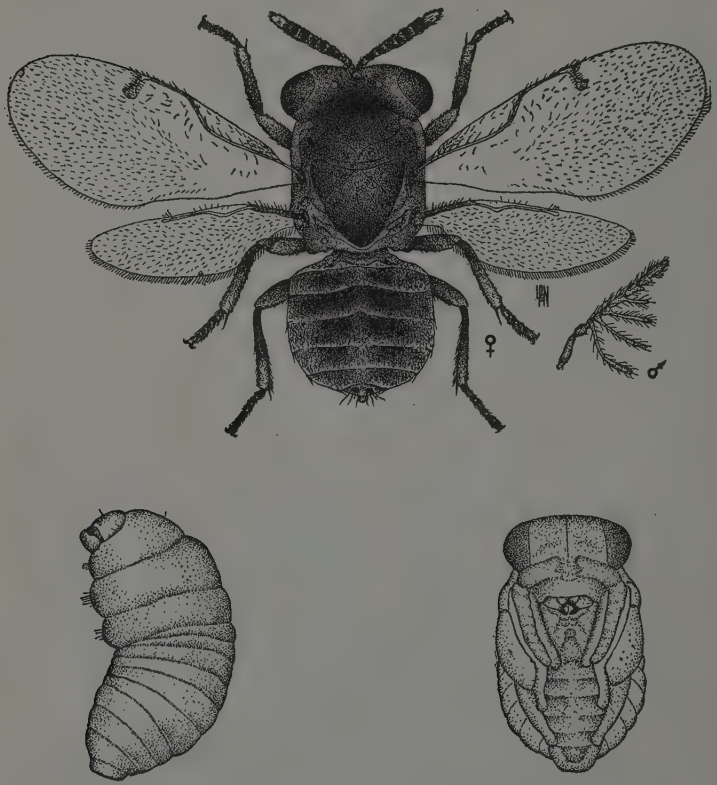

Fig. 1.—Adult female of the logwood seed chalcid, *Tanaostigma haematoxyli* Dozier, male antenna, full-grown larva and pupa, all greatly enlarge (original)

TECHNICAL DESCRIPTION

Tanaostigma haematoxyli, new species.

This species appears to be much stouter than *T. coursetiae* Howard and differs from that species distinctly by its different coloration and

by having the female scape less flattened. Both sexes of this species show considerable variation in size but the male is usually decidedly smaller. The variation in size of individuals is due most probably to different moisture conditions and food available in different seed pods.

Female. Length 1.21–1.46 mm.; expansion 2.84 mm.; greatest width of forewing 0.573 mm. The general appearance of the female is stout and compact, the thorax decidedly humped or convexly elevated; slightly pubescent with light colored hairs. General color a dark honey-yellow, the vertex and more dorsal portions of the thorax and abdomen more or less infuscated giving a fuscous appearance except along the sides; the sides of the abdomen are pale in color. Antennae dark brown except the pale ring-joint and the white club; 11-jointed; club apparently solid; pedicel nearly twice as long as wide, followed by a small ring-joint and a second larger and darker joint that borders on being a true ring-joint, decidedly smaller and narrower than the funicle joints which are subequal in length and only slightly widening to the club. Head transverse. Pronotum narrower than the head and slightly longer, the scutellum convexly elevated, with reticulate markings or areas on surface. Forewings hyaline, venation pale brown, the stigmal vein very thick, covered with numerous curved setae. Under high magnification, specimens mounted in balsam, show the thorax and abdomen to be distinctly reticulated. Legs brown, the hind tibiae armed with pale rigid bristles along the inner margin.

Male. Length 0.86–1.37 mm.; expansion 2.65 mm.; greatest width of forewing 0.502 mm. Easily distinguished from the female by its smaller size, narrower and more slender build, lighter coloration, and immediately by its branched antennae. General color similar somewhat to that of the female but lighter yellowish. Antennae 13-jointed, composed of a rather broad scape, short stout pedicel, a pair of minute ring-joints, theh next five funicle joints increasing in length, each one with a lateral prolongation, successively shorter, giving a branched appearance; the last funicle joint is slightly shorter than the two preceding and has only a suggestion of a short lateral prolongation.

Described from a large series of both sexes, mounted on cardpoints, in balsam on slides, and in alcohol, U. S. National Museum Type No. 43939; reared in vast numbers from seeds of logwood, *Haematoxylon campechianum* L. Hinche, Haiti, Jan. 18, 1930, and at Damien, Haiti, Feb.–March 1931 by the writer.

Larva. Length .85 mm. The fullgrown larva is 13-segmented, the anterior three segments being distinctly wider than the remainder. Pale creamish white in color.

Pupa. Length 1.75 mm.; greatest width .75 mm. Pale creamish color at first but as development proceeds the eyes become distinctly reddish and the mandibles take on a reddish, chitinized appearance. Just prior to issuance of the adult, the pupa becomes very much darkened.

DISTRIBUTION

The logwood is indigenous chiefly to the mainland of tropical America, being most abundant in southern Mexico, Tobasco, Campeche and Yucatan, and throughout Central America, and fairly common in Colombia, Venezuela and the Guianas. It seems to be possibly native to Hispaniola, as the wood is said to have been exported from Santo Domingo to Spain in the latter part of the sixteenth cen

Figure 2.—Cluster of logwood seeds, completely destroyed by the work of *Tanaostigma haematoxyli*, new species, slightly reduced (original)

tury. It is called "campeche" in Haiti, and there as well as in Jamaica is the chief honey plant of the island. It was reported as having been introduced into Jamaica about 1715 by means of seed from Honduras. It would therefore be very interesting to find out if the seeds are attacked by this wasp in the other parts of its range.

A letter from Mr. H. H. Coote, Instructor in Beekeeping in Ja-

maica, dated Feb. 25, 1930, states "From the beekeeping standpoint we look at the logwood as a great asset and although it is attacked here by a similar insect we have no reason to be alarmed as we have more young trees coming forward than those that are cut down for commercial purposes". In Haiti, however, the logwood is being rapidly and relentlessly cut out for export for the dye industry and this together with the destruction of 90 per cent of its annual seed crop by this wasp accounts for the diminishing amount available in that country and for the poorer honey yields of more recent years.

Figure 3.—Seed-pods of logwood, *Haematoxylon campechianum* L., in various stages of development, showing oviposition scars and exit holes, natural size (original)

SEASONAL OBSERVATIONS

The main flowering of the logwood and consequent honey-flow in the vicinity of Damien, Haiti, starts in January and there is nearly always a second blooming. In other sections of the island there are as many as three different extractions. In the Hinche region the log-

wood usually starts to bloom about November 29th with the largest honey-flow starting again in January. As the logwood is rather irregular in blooming we find usually some straggling or late blooms at the same time as young and fully-developed pods and as the blooming season varies with different regions it appears that this wasp carries itself over from one season to the next without difficulty.

The writer observed the logwood in full bloom at Hinche, in the Central Plains district, on Jan. 9, 1930. On this date vast numbers of a very small greenish-yellow psyllid, nymphs and adults, were present on every flower cluster examined and these were turning black and drying up as a result of the continual sucking of these small insects. Old seed pods still clinging to the trees showed hundreds of adult *Tanaostigma* issuing. A second trip made January 16th showed practically no new seed had set, all of the flower clusters having dried up. Automatically with this the honey-flow ceased. From the old pods thousands of the *Tanaostigma* were still issuing to continue the destruction of any seed that might have set.

At Damien and Port-au-Prince adult *Tanaostigma,* the first observed in 1930, started issuing on February 2nd in vast numbers. The writer observed a few adults of the same psyllid and a few *Tanaostigma* adults at logwood bloom near St. Michel du Sud on Feb. 17th and from seed pods collected at Fond-des-Negres the first adults started to issue Feb. 18th. During February observations were made by Messrs. G. Kolbjornsen and A. Daumec, Agricultural Inspectors, throughout the entire Artibonite valley and they reported practically 100-per-cent destruction of logwood seed wherever examined, finding only exit holes as the adults had already issued. Attacked seed was reported by Mr. Parisot at Thozin in the Commune of Grand Goave, March 16, 1930.

Close observations were made during 1931. The logwood started to bloom in the regions of Port-au-Prince and Damien about January 1st. At Verrette the writer observed newly formed pods with very young larvae of *Tanaostigma* developing inside the seeds on Jan. 15th. By February 28th the large new crop of seed pods at Damien showed 100-per-cent infestation but only a few of the adults had issued by that date. A large amount of material was placed in battery jars and field observations continued. By March 20th nearly all of the adults had issued. Due to the prolonged flowering, even at that date there were a few late blooms on the same trees and the young pods practically all contained pupae.

HABITS AND CHARACTER OF INJURY

The adult wasps soon after issuing were observed to start mating, actively running over the seed pods. The eggs are extremely small and are deposited within the young tender pods by means of the ovipositor. The oviposition scars are readily visible from the outside and each seed is occupied by a larva. The consequent reaction produces a gall-like deformation of the seeds and with it the pod is definitely thickened along the middle. Fig. 3 shows various seed pods, illustrating the different stages of development from the oviposition scars to the exit holes of the adults.

The result is that in many cases every seed in the entire cluster of pods is completely destroyed. In this way the logwood is prevented from re-seeding itself. Observations made over the two-year period show that this is serious. Fortunately, however, the logwood is so prolific that it is probably capable of producing enough seedlings to replace itself if freed, even at long intervals, from the attack of this wasp by unusual activity and restraint on the part of its parasites.

PARASITISM

On March 16, 1931, the contents of one rearing jar were examined and counted with hand tabulators, yielding 5223 adult *Tanaostigma* and 352 parasites or 6.75-per-cent parasitism. There were two species of parasites involved and these have been determined by Mr. Gahan as *Eupelmus* sp. and *Horismenus* sp., the latter being the smallest and of a distinct metallic green color.

The Annona Seed Chalcid

DISTRIBUTION

This rather large chalcid wasp, *Bephrata cubensis* Ashmead, was described in 1894 (Descr. New Parasitic Hymneoptera, Trans. Am. Ent. Soc., vol. 21, p. 321, Sept.). The first record of its attacking *Annona* seeds was that published by J. C. Crawford (Proc. U. S. National Museum, vol. 41, p. 274, 1911). There are specimens in the U. S. National Museum, determined by Mr. Gahan, reared from *Annona* seeds at Santiago de las Vegas, Cuba, by P. Cardin, Dec. 26, 1910; from seeds of the custard apple and sour sop at Cross Roads, Jamaica, A. H. Ritchie; and from *Annona squamosa* fruit at Miami, Florida, Dec. 15, 1921, reared by G. F. Moznette. In addition, the writer observed the exit holes of this insect to be numerous in fruits

of the "guanábana", *Annona muricata*, in Porto Rico in 1925 * and has reared adults in Haiti in 1931. This shows that *Bephrata cubensis* has a rather wide range through the West Indies at least and occurs in Florida.

TECHNICAL DESCRIPTION

Female. Length 6.5–7.25 mm. Of a testaceous to rufous-orange color when fresh, except for the petiole and last thoracic joint adjoining which are black. Antennae with scape pale, marked with fuscous adjoining the dark pedicel; the entire funicle deep brownish-orange, turning darker after death. Eyes red. Ocelli

Figure 4.—Adult female wasp, *Bephrata cubensis* Ashmed, that attacks the seed of annonaceous fruits, greatly enlarged (original)

black. Legs testaceous except for slight infuscation on the femora. Umbilicately punctate, the head, thorax and petiole dull. Petiole short. Abdomen shiny, much compressed, slightly longer than the head and thorax combined, roundingly and prominently elevated from the base, then depressed downwards in a rounding curve to a pointed tip from which the ovipositor projects slightly. Frons with a deep antennal groove. Wings hyaline with a distinct fuscous cloud or infumation beneath the marginal vein.

Male unknown.

* This seed chalcid was reported by O. G. Anderson (determined by C. F. W. Muesebeck) as infesting one out of four fruits of "corazón", *Annona reticulata*, examined at Villalba on October 27, 1931—Editor's Note.

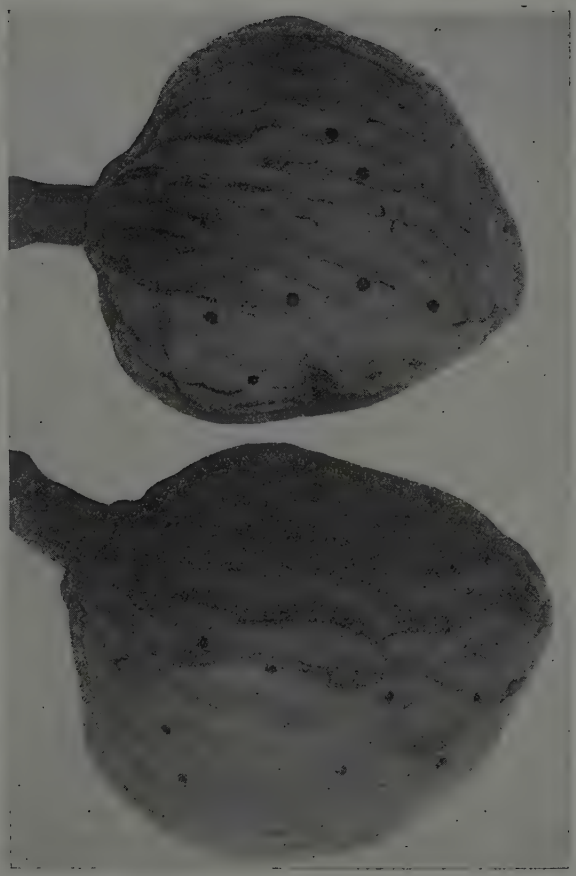

Figure 5.—Fruits of *Annona reticulata* showing openings through which *Bephrata cubensis* have emerged.

OBSERVATIONS

Fruits of "cachiman coeur-boeuf", *Annona reticulata,* were collected at Damien Haiti, on April 16, 1931 and were placed in rearing jars. On that date exit holes were already present in various fruits and during the period from the 17th to the 24th, a total of 17 females were reared from this fruit. The adult Eurytomid wasp lays her eggs in the young developing fruits and the larvae develope inside of the seeds, gradually consuming them. The insect leaves the fruits as an adult, gnawing exit holes as shown in Fig. 5. Similar holes are very common in fruit of the "corosol", *Annona muricata,* in Haiti, and three adults were reared from this fruit May 3, 1931.

REFERENCES

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1890 **Howard, L. O.** A New and Remarkable Encyrtid: Is it Parasitic?, Insect. Life, vol **3,** p. 147.

THREE SPECIES OF *EMPOASCA* LEAFHOPPERS KNOWN TO AFFECT ECONOMIC PLANTS IN HAITI (INCLUDING THE DESCRIPTION OF TWO NEW SPECIES)*

By DWIGHT M. DELONG
Professor of Entomology, Ohio State University

For many years it has been the opinion of entomologists that *Empoasca fabae* Harris, the potato leafhopper was a pest occurring in all parts of the United States and Central and South America. Recently the writer [1] has been able to distinguish the species of Empoasca by the male genital pieces and has then shown by field studies [2] that other important species are concerned and that these instead of *fabae* are the important economic forms in certain areas of the United States. Following this study of characters, Dr. R. C. Smith then located at Port-au-Prince, Haiti, forwarded to the writer a large series of specimens collected from beans and sweetpotatoes in that locality. Upon examination it was found that these were not *fabae* and the species was described as *E. fabalis* DeL.[3] According to the survey made by Dr. Smith when these specimens were collected the species was extremely abundant upon beans and sweetpotatoes and was considered the most important species of economic leafhopper in Haiti upon truck crops.

More recently Dr. H. L. Dozier forwarded three different lots of material collected in the same area one of which has proven to be *fabalis* which he collected from sweetpotatoes. The other two species, one collected from cotton and another from *Canavalia* are apparently undescribed. There is a possibility therefore that the three have been considered as one species and each of these may be important economically. The descriptions together with an illustration of the male genital structures of each are included below.

Empoasca fabalis DeLong.
Canadian Entomologist LXII p. 92 April 1930.

Resembling *fabae* in size, form and appearance but with distinct genital characters. Length 3 mm.

* Editor's Note: *E. fabalis* is widely distributed and injurious to lima and string beans in Puerto Rico and has also been reported as injurious to tomato. The species commonly present on sweet potato here has not as yet been specifically determined but is quite probably *fabalis*. The cotton leafhopper in Porto Rico may also be *E. gossypii* herein described as new.

[1] U. S. D. A. Tech. Bull. 231, January, 1931.
[2] Jour. Eco. Ent. Vol. 24, p. 475–480, April, 1931.
[3] Canadian Entomologist LXII, p. 92, April, 1930.

Vertex strongly produced about one-third its length before anterior margins of eyes. One-third wider between eyes than length at middle. Pronotum one-third longer than vertex.

Color pale green without distinct markings. Usually with irregular mottling and varying longitudinal stripes, white. A pair of oblique dark green spots either side of, and back of apex.

Genitalia: Female last ventral segment roundingly produced and entire. Male valve twice as long as preceding segment, posterior margin almost truncate. Plates long and narrow, gradually tapered to rather acute tips, more than twice as long as valve.

Male internal genital structures: In ventral view styles short, slender, very narrow at apices which are bent outwardly. Lateral processes of pygofers long and tapered. Apical fifth very narrow and slightly bent inwardly (in ventral view). Dorsal spines of pygofers heavy at base but rapidly narrowed to ventrally directed and slightly anteriorly hooked processes.

Empoasca gossypii new species.

Appearance and general form of *fabae* but smaller and with distinct male genitalia. Length 2.8 mm.

Vertex almost one-third wider between eyes than length at middle. Pronotum two-fifths wider than long. Humeral angles prominent, posterior margin strongly concave.

Color greenish marked with white and yellow. Vertex yellowish green mottled with white. Pronotum yellowish, subhyaline. Anterior and lateral margins marked with white. Scutellum mostly white. Elytra greenish, subhyaline with yellowish green longitudinal stripping sometimes very faintly colored.

Genitalia: Female last ventral segment as long as basal width. Posterior margin with lateral angles rounded and slightly indented either side of a median slightly produced broadly angled lobe which is about half the width of the segment. Male plates more than two and one-half times as long as combined width at base rapidly narrowed to compressed, flaring, and upturned apices. Ventrally set with long brownish spines.

Male internal genital structures: Styles strongly curved outward apically in ventral view. Lateral processes of pygofers short and rather stout, gently curved dorsally. Dorsal spines of pygofers wide at base curved ventrally, bifurcate apically.

This is the only species of Empoasca except *bifurcata*, a common species in the Eastern United States, which is known to have a bifurcate dorsal spine. It can easily be distinguished from the other described species in Haiti by this character.

Described from 35 female and male specimens collected from cotton at Hinche, Haiti, September 12, 1931, by Dr. H. L. Dozier.

Holotype male labeled Hinche, Haiti, September 12, 1931.

Empoasca canavalia new species.

Resembling *fabae* in general appearance but smaller and with distinct male and female genital characters. Length 2.8 mm.

Vertex bluntly angularly produced almost one-third wider between eyes than length at middle. Pronotum more than twice as wide as long. Elytra exceeding abdomen by about one-fourth their length.

Color variable, usually some shade of green. Vertex yellowish or orange yellow marked with green. Two rather bright green areas on disc either side of vertex. Pronotum and elytra greenish subhyaline.

Genitalia: Female last ventral segment two-thirds as long as basel width. Posterior margin concavely rounded to produced central tooth which is more than one-third the width of the segment and is slightly notched at center. Male plates one-third longer than combined width at base apices rather sharply pointed and upturned. Sides straight.

Male internal genital structures: In ventral view styles gently curved outwardly. Lateral processes of pygofers as seen in lateral view rather broad, constricted near apex and terminated by a slender curved finger process. Dorsal spines of pygofers large, broad at base, produced downward and inwardly, appearing to cross each other in ventral view, gradually tapering to pointed tips.

Described from 48 female and male specimens collected from Jack Bean, *Canavalia ensiformis* (L) D. C. at Damien, Haiti. September 14, 1931, by Dr. H. L. Dozier who sent them to the writer for identification.

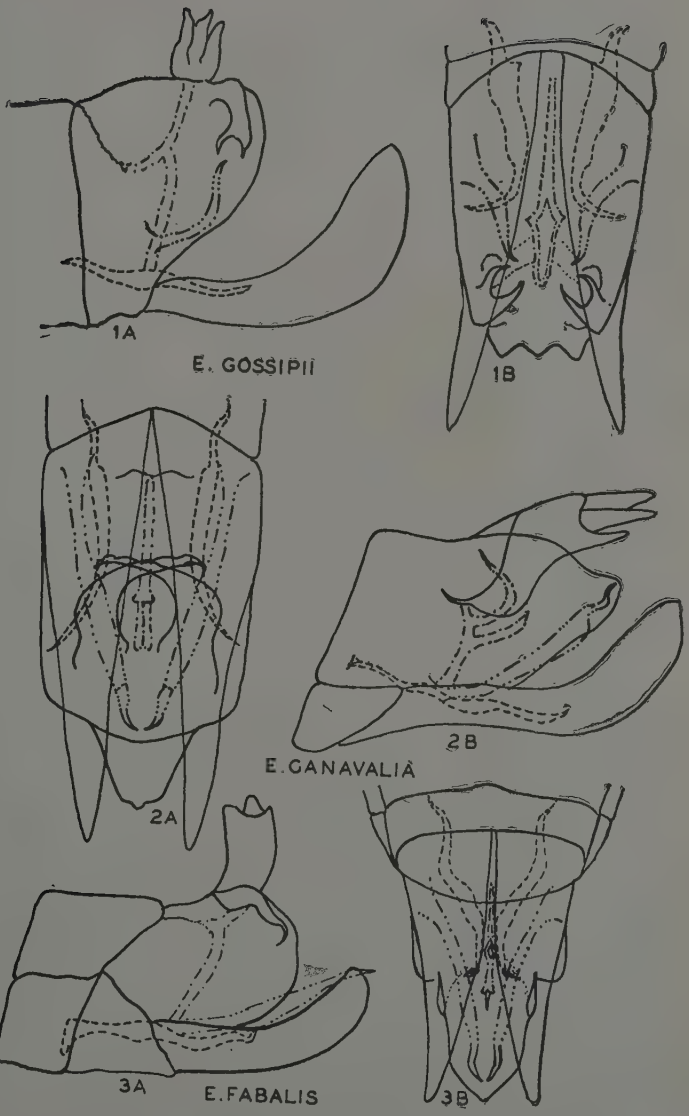
Holotype male labeled Damien, Haiti, September 14, 1931.

Explanation of Plate XIII

(showing male genitalia)

1 A.—E. gossipii n. sp. lateral view
1 B.—E. gossipii n. sp. ventral view
2 A.—E. canavalia n. sp. ventral view
2 B.—E. canavalia n. sp. lateral view
3 A.—E. fabalis De L. lateral view
3 B.—E. fabalis De L. ventral view
----------Style
—.—.—.—. oedagus
—...—...— lateral process of pygopher

PLATE XIII



A NEW CITRUS CAMBIUM MINER FROM PUERTO RICO

By E. P. Felt
Bartlett Tree Research Laboratories, Stamford, Connecticut.

The species described below was reared by Dr. G. N. Wolcott from larvae working as cambium miners in grapefruit twigs about the diameter of one's finger and causing a darkened discoloration of the twigs. The larvae of this Itonid made cocoons in the soil July 11 and the adults emerged July 15, 1931 at Isabela, Puerto Rico. The material was submitted for study later that month by Dr. M. D. Leonard, Chief Entomologist of the Insular Experiment Station, Río Piedras.

The species is rather closely related to the West Indian *Asynapta mangiferae* Felt, a species reared from larvae working under the bark of small twigs of grafted mango, probably *Mangifera indica*. (See Entomological News, **20**: 299. 1909.)

Asynapta citrinae new species.

The new species may be differentiated by the larger number of antennal segments, the longer stem of the fifth antennal segment and the decidedly shorter length of the enlargement in the male, and the decidedly longer subcylindrical fifth antennal segment in the female.

Larva. Length, 3 mm., yellowish white, tapering anteriorly, a rudimentary breast bone, posterior extremity truncate, ventrally indistinctly bilobed.

Male. Length, 1.75 mm. Antennae as long as the body, sparsely haired, fuscous yellowish; 24 segments, the fifth with a stem as long as the basal enlargement, the latter with a length one-fourth greater than the diameter; the terminal segment reduced, the basal portion with a length about three-fourths its diameter, apically short and stout. Palpi; first segment subquadrate with a length about twice the diameter, the second a little longer than the first, more slender, the third one-half longer than the second, more slender, the fourth one-fourth longer than the third and more slender. Head fuscous yellowish, eyes large, black. Mesonotum, fuscous yellowish. Scutellum and postscutellum, yellowish. Abdomen, fuscous yellowish, the segments rather thickly haired distally. Genitalia yellowish. Wings hyaline. Halteres pale yellowish. Coxae and femora mostly pale yellowish, tibiae and tarsi pale straw. Claws stout, unidentate. The pulvilli rudimentary. Genitalia indistinct in the preparation.

Female. Length, 1.75 mm. Antennae about three-fourths the length of the body, thickly haired, pale yellowish; 24 subsessile segments, the fifth with a length one-fourth longer than the diameter; the terminal segment somewhat produced, narrowly conical, with a length nearly twice its diameter. Palpi; prac-

tically as in the male. Head, pale yellowish, eyes large, black. Mesonotum, pale orange yellow. Scutellum and postscutellum, yellowish white. Abdomen, pale yellowish. The ovipositor short, basal lobe subquadrate with a length about one-half greater than its diameter, the terminal lobe narrowly oval, sparsely haired. Wings hyaline. Halteres pale yellowish. Coxae and femora basally whitish, the femora distally, tibiae and tarsi pale straw.

Types deposited in the United States National Museum.

A NEW NEOTROPICAL GENUS OF EUPTERYGINAE (HOMOPTERA) FROM PUERTO RICO

By W. L. McAtee,
U. S. Bureau of Biological Survey, Washington, D. C.

Specimens of this new form have been on hand for a decade or more, but the need of describing it did not become apparent until it was sent in as an "economic" insect. Recent collections indicate that the leafhopper is injurious to the mamey (*Mammea americana*) or so-called tropical apricot.

Among Euteryginae the genus is characterized first by lacking an appendix to the tegmen, and by having the apical cells of the wing closed posteriorly. It belongs therefore in the tribe Dikraneurini, and in that group its diagnostic characters are: Submarginal vein of wing approaching costal margin, not continuous with first sector, cross veins completely lacking; cross vein one lacking in tegmen, and apical veins of tegmen straight and parallel. They are also practically direct extensions of the sectors.

The name *Hybla* is proposed for the genus and the genotype is the following species:

Hybla maculata new species

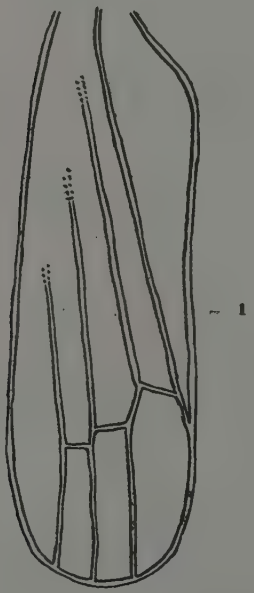
Form distinctly depressed; vertex subangulate anteriorly, about equal in length to pronotum; head across eyes wider than pronotum; venation as shown in the accompanying figures (which were sketched by J. R. Malloch and inked in to their detriment by the writer).

General color pale lemon yellow above, whitish below. The dorsal surface is ornamented by a number of black spots of which pairs on the vertex, pronotum, and clavi are conspicuous. There is a small spot near base of each corium, another on corium near middle of claval suture, a spot at each end of costal plaque, of which the hinder about equals in size that near base of clavus, these being the largest of all. There is a small spot near apex of clavus, one in vicinity of junction of third sector and the corresponding apical vein. All of these spots are discrete, dense, and more or less elliptical in shape. The apex of tegmen is somewhat fumose, with denser blackish cloudings or even dense spots in both the (hypothetical) first and in the fourth apical cells. The eyes are greenish black, and there is a black spot on each mesopleurum. The spots vary somewhat in size and intensity, the pair on vertex being reduced in several specimens and entirely lacking in a few. Length 2.2–2.3 mm.

Described from a number of specimens of both sexes, including therefore both the holotype and allotype, labelled Barceloneta, Puerto Rico, May 3, 1932, on mamey, R. Faxon and A. C. Mills; and others

from the same locality and food plant, March 22, 1932, A. S. Mills and C. G. Anderson; Pt. Cangrejos, Puerto Rico, Jan. 13, 1920, G. N. Wolcott; and Santo Domingo, G. N. Wolcott. (All material in the United States National Museum.)

There may be some tendency to confuse this species with the spotted form (*moznettei*) of *Empoasca minuenda* Ball.* The arrangement of the spots, however, is different in that insect, which furthermore is not at all depressed in form. Both of these forms in contrast to *Empoasca* belong to the section of Dikraneurini that



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LEGEND FOR FIGURES

1. Tegmen, 2. Wing, of *Hybla maculata.*

has the submarginal vein of the wing connivent or nearly so with the costal margin and not continuous with the first sector. *Hybla maculata* lacks, while *minuenda* possesses, a crossvein in the wing. *Empoasca minuenda* was named ** by DeLong as the type species of a subgenus *Idona* of *Empoasca;* it is not an *Empoasca* however and apparently must be recognized as a distinct genus.

* Proc. Biol. Soc. Wash. 34, pp. 23–24, March 1921 [Florida].
** Tech. Bul. 231, U. S. Dept. Agr., Jan. 1931, p. 59.

INSECT CONDITIONS IN PUERTO RICO DURING THE FISCAL YEAR, JULY 1, 1930 THRU JUNE 30, 1931

By M. D. Leonard
Entomologist, Insular Experiment Station, Río Piedras, P. R.

ALFALFA

The alfalfa leaf-tyer, *Dichomeris piperatus* Wlsm., was injurous on the experimental plots at the Isabela Sub-Station from April thru June but possibly not quite so injurious as last year, especially during April; no observations were made during the first half of the year but the insect was surely present.

The fall armyworm, *Laphyma frugiperda* S. & A., did considerable damage in June, 1931 at the Isabela Sub-Station but was checked by being eaten by the giant toad, *Bufo marinus* L., which ate the caterpillars after the alfalfa was cut.

BAMBOO

The bamboo scale, *Asterolecanium bambusae* Bvd. (H. Morrison det.) was reported as heavily infesting bamboo at Cidra and at Mayagüez in August and September (A. S. Mills) and as infesting bamboo at Maricao in January (A. G. Harley). It was however undoubtedly generally distributed and common throughout the Island.

BANANA

The banana root-borer, *Cosmopolites sordidus* Germ., was more or less injurious throughout nearly all parts of the Island, its status undoubtedly being about the same as during the previous year. During March and April however a survey made on about 800 farms compirsing about 50,000 acres in the Districts of Ponce, Guayanilla and Peñuelas which were previously thought to be free of the pest or nearly so, showed that Ponce ranged from 7–20 per cent infested and initial infestations were found scattered thruout the other two Districts.

The West Indian cane weevil; *Metamasius hemipterus* L. was reported as abundant and generally distributed in the bananas examined in the above survey.

BEANS

The lima bean pod-borer, *Maruca testulalis* Geyer, was undoubtedly present wherever lima or string beans were grown in the Island but has actually been observed only at Río Piedras, Isabela, Mayagüez and Cidra. All indications point to the fact that it is more abundant during the fall and winter months and scarce to sometimes absent during the summer. The fact that beans both string and limas are more commonly grown during the winter is undoubtedly largely but probably not entirely responsible for this difference in abundance.

Another bean pod-borer, *Etiella zinckenella* Treit., has been found to be widely distributed and fairly abundant at least in the lower parts of the Island; it also occurs in Vieques Island. During the spring it was considerably more common at Isabela than Maruca as a bean pod-borer and the same was true but possibly to a somewhat less extent at Río Piedras during the previous fall and summer. We have reared it in the latter place during the summer and fall of 1931 from lima beans crotalaria, cowpeas, and pigeon peas, in which latter it is even more common than in lima beans.

The cowpea pod and stalk borer, *Fundella cistipennis* Dyar., was reared a number of times from lima beans during May 1930 and altho it was not observed infesting beans during the past fiscal year it was undoubtedly present in fair numbers.

A leaf beetle, *Ceratoma denticornis* Fab., was fairly common on string beans at the Station during March and April but apparently not doing much damage. No other definite observations were made during the year but the insect was probably fairly common and general as is usual wherever string beans were grown.

A leaf-beetle, *Diabrotica graminea* Baly, was present and fairly common in several places observed but doing only moderate damage to string beans. It was also recorded on Irish potatoes and mung beans in June, both of which see.

The bean lace-bug, *Corythucha gossypii* Fab., has been moderate to abundant and injurious to both lima and string beans wherever grown and more or less thruout the year, altho as usual it was more abundant and injurious during the summer months.

The corn earworm, *Heliothis obsoleta* Fab., was found lightly infesting about 1 per cent of the pods at harvest time of about 1 acre of string beans at the Station at Río Piedras.

A leafhopper, *Empoasca fabalis* De Long, was moderated to abundant and injurious to both lima and string beans wherever grown thruout the year; several patches of string beans observed which had

not been sprayed were practically destroyed by the insects which were extremely abundant.

The bean leaf-roller, *Goniurus proteus* L., was present in most plantings of both string and lima beans observed during the year but as a rule not doing a great deal of damage.

The bean leaf-webber, *Lamprosema indicata* Fab., was only observed doing moderate damage at Río Piedras in several plantings of lima beans during the late fall.

Larvae of the greenhouse leaf-tyer, *Phlyctaenia rubigalis* Gn., were observed as doing considerable damage to the foliage of string beans in January and February.

Larvae of the rattlebox moth, *Utethesia ornatrix* L., were abundant in string-bean pods at Río Piedras in January and February.

"Vaquitas," *Diaprepes spengleri* L., were observed eating the leaves of string beans to a considerable extent at Isabela in January or February.

The bean aphid, *Aphis rumicis* L., was observed lightly infesting a ½-acre patch of string beans at Manatí on Mar. 7, 1931 (A. S. Mills & E. G. Anderson; P. W. Mason det.). This is apparently the first definite record of the insect for Porto Rico.

The eggplant stem-borer, *Baris torquatus* Oliv., on beans (See under eggplant.

BEETS

A leaf-beetle, *Disonycha laevigata* Jacoby, was abundant and doing considerable damage to a fair-sized garden patch of both beets and Swiss chard at Palo Seco on Aug. 29, 1930. The grower stated that these beetles had troubled him for several years and had necessitated constant control measures (M. D. Leonard & A. S. Mills).

Moths of the smaller beet webworm, *Hymenia fascialis* Cramer, were not uncommon at lights at Aguirre the end of June. Infested beets were only observed at Palo Seco, mentioned above, at which time they, as well as the Swiss chard, were infested to a considerable extent with this webworm.

BIDENS PILOSA

See *Protalebra brasiliensis* De Long under SUGAR CANE.

CABBAGE

The diamond black moth, *Plutella maculipennis* Curtis, was abundant and injurious thruout the year wherever cabbage was grown, but as usual was less active during the winter months.

A leaf-miner, probably *Agromyza inaequalis* Malloch, was fairly common on plants grown at the Station in Río Piedras in April; definite observations were not made during the rest of the year.

A weevil, *Lachnopus curvipes* Fab., was found on a cabbage plant at Río Piedras, Jan. 5, 1931 (Mills and Anderson; L. L. Buchannan det.).

CACTUS

The cactus scale, *Diaspis echinocacti opuntiae* Ckll. (Morrison det.) on a cactus (Opuntia ?), Coamo Sept. 30, 1930 (A. G. Harley) and one plant of *Opuntia brasiliense,* moderately infested in Santurce, Mar. 24, 1931 (R. Faxon and A. S. Mills).

CARNATION

A scale insect, *Pseudoparlatoria ostreata* Ckll. (Morrison det.), was submitted the end of June by M. A. Díaz of the Department of Agriculture with the report that it was badly infesting a number of plants in a garden at Martin Peña.

CASSAVA

Red spiders, *Tetranychus* sp., were somewhat less abundant and injurious during the fall than during the spring and summer of 1930 due to more rain in the fall.

The cassava shoot-borer, *Lonchaea chalybea* Weid., was common on isolated plants at the Station thruout the year.

CASTOR BEAN

The bean lace-bug, *Corythucha gossypii* Fab., was present in moderate numbers on castor-bean foliage in several localities observed in the late summer of 1930 but was undoubtedly present to a greater or less extent in all parts of the Island thruout the year.

CHAYOTE

The pickle worm, *Diaphania nitidalis* Cramer, was first found infesting about 20 per cent of the fruits in one of the largest plantings in Lares in October, 1930. From then on into March fruits were found at frequent intervals in the market in Río Piedras averaging 5–10 per cent infested. Since that time no observations have been made. First record of definite food-plant or locality for Porto Rico.

CITRUS

Scale insects, principally the purple scale, *Lepidosaphes beckii* Newm. and the Florida red scale, *Chrysomphalus ficus* Ashm. were apparently general and about as injurious as usual, several large growers reporting them worse than during the previous year and other growers as not so abundant.

The green scale, *Coccus viridis* Green, was obtained early in June lightly infesting a number of young grapefruit trees at the Isabela Sub-Station. It was probably on citrus in other places but observations were not made except near Isabela where during the month infestations of green scale almost disappeared from at least 4 grapefruit plantings observed due to heavy rains, growth of windbreaks and spraying with oil combined.

The woolly white fly, *Aleurothrixus floccosus* Mask., moderately infested about 20 young Meyer lemon trees on the Station grounds in April at Río Piedras.

The rust mite, *Phyllocoptes oleivorus* Ashm., was apparently not as injurious on the whole as during the previous year.

The "vaquita grande", *Diaprepes spengleri* L., did considerable damage as usual especially during May and June to the foliage in the citrus sections by entirely stripping off new growths and by the larvae injuring the roots. It was reported that in the Bayamón section the adults caused considerable drop of young grapefruits (tho no more than usual) by cutting them off at the point of attachment to the stems.

The "vaquita verde", *Exopthalmodes roseipes* Chev., also did some damage to foliage in the main citrus section during the summer and according to one of the best growers caused some injury to the fruits in June 1931 in his locality.

June beetles, undoubtedly involving mostly *Phyllophaga vandinei* Smyth, and *P. citri* Smyth, were injurious to both young and old trees due to feeding of the adults on the leaves (mostly during May and June) and the larvae on the roots. In January about ⅓ of 30,000 grape fruit seedlings were reported killed by white grubs in a nursery at Bayamón. It is felt, however, that these insects have been less injurious during the past 2 or 3 years than formerly in at least the older parts of the citrus-growing section around Bayamón due to the introduction in 1926 of the toad, *Bufo marinus* L., in small numbers into several groves and their subsequent great increase. One large grower stated that he had found as high as 20 beetles in the stomach of a single toad.

Ants, especially the brown ant, or "hormiga brava", *Solenopsis geminata* Fab., were injurious to citrus as usual and required control measures by many growers.

Thrips injury to citrus fruits has only once before been recorded in Porto Rico. During the past year the writer has several times observed thrips in fair numbers in the blossoms but no specimens were collected for determination. Many grape-fruits have also been seen in several packing houses which certainly show characteristic "thrips injury" but more detailed observations will have to be made.

The bean lace-bug, *Corythucha gossypii* Fab., was found for the first time in Porto Rico moderately infesting several young lemon and orange trees at Isabela in April; in May a light infestation of several young grapefruit trees was observed at Río Piedras. It is interesting to note that recently Brunner observed the insect on cifron foliage in Cuba.

A very common injury to oranges has been prevalent again this past year in several parts of the citrus growing section, especially the Eastern part. When the fruits are fully-grown but still green to nearly ripe a very small hole is often found underneath which the pulp becomes soft and juicy and breaks down. Often these holes are enlarged apparently by birds which probably peck into them to extract the larvae of such scavangers as Nitidulid beetles, *Drosophila* larvae and especially larvae of the spotted rootfly, *Euxesta notata* Wiedemann, which latter has often been found therein and adults reared. The real cause of the original small holes is not known, but certainly the Euxesta fly is not primarily responsible. Considerable loss occurred to a number of growers during the year.

A leaf-footed plant-bug, *Leptoglossus gonagra* Fab., did considerable injury from the latter part of November into December in a 65-acre grape-fruit grove at Pueblo Viejo. At the same time about 10 acres of grapefruits were attacked a little west of Bayamón and caused about 10 per cent of the fruits to drop. The bugs were in enormous numbers and were breeding on the wild balsam apple, *Momordica charantia* L., which was very common in the grove. The adults flew to the ripening fruits and made small feeding punctures under which the pulp became broken down and often had a slightly rotten odor and a bitter taste. By the first of January all trouble was over and it was reported that very few of the bugs could be found in either grove.

The Fulgorids, *Bothriocera bicornis* Fab. and *Ormenis infuscata* Stal. (P. W. Oman det.), on grapefruit leaves at Añasco, Nov. 5, 1930 (A. G. Harley).

CANNA

The canna leaf-roller, *Calpodes ethlius* Cramer, was observed early in June to be moderately infesting a number of plants at Isabela.

COCONUT

Rhinoceros beetle, *Strataegus quadrifoveatus* P. de B., was generally distributed and destructive thruout the whole coastal area of the Island. It was most abundant however in the coconut-growing sections of the following municipalities: (Western Section) Aguadilla, Aguada, Moca, Rincón, Añasco, Mayagüez, Hormigueros, Cabo Rojo and Lajas; (Northern Section) Barceloneta, Manatí, Vega Baja, Vega Alta, Carolina and Loíza; (Eastern Section) Yabucoa and Humacao. In these an intensive clean-up campaign was carried on by the Agricultural Extension Division from September to July during which there were collected a total of 370,844 larvae and of 27,498 beetles by boys to whom a total of $3,354.49 was paid. They received from 5 to 10 cents per dozen.

The coconut scale, *Aspidiotus destructor* Signoret, according to Mr. Ferdinand Méndez, in charge of the coconut bud-rot clean-up campaign, was generally distributed throughout the Island. It was particularly injurious however at Boquerón near Cabo Rojo and at Patillas. At Boquerón serious damage was done to a young plantation and at Patillas many old bearing trees were badly infested.

COFFEE

Adults of the coffee stem-borer, *Apate francisca* Fab., were taken from dead twigs of tamarind at Tallaboa by A. G. Harley on Nov. 8, 1930 (W. S. Fisher det.). In March there was a severe infestation at Lares in which about 100 coffee trees on about 1 acre were injured; guava were also injured and an orange, an aguacate and some pomarrosa (*Jambos Jambos*) fence posts were also slightly injured; burrows were also found in two achiote trees (*Bixa orellana* L.) and 50 infested pigeon-pea plants had been cut and burned. A couple of weeks later early in April the infestation had apparently subsided. A few coffee trees were reported infested at Guayanilla during April.

The green scale, *Coccus viridis* Green, was collected by Faxon, Harley and Mills of the U. S. P. Q. & C. A., (det. by Morrison,) on June 25, 1931, on coffee at Maricao but abundance was not stated. In April it was observed lightly infesting several varieties at the Station in Río Piedras and in June a number of young grapefruit

trees at the Isabela Sub-Station were found lightly infested. It is undoubtedly widely distributed in Porto Rico on coffee and citrus.

The coffee leaf miner, *Leucoptera coffeella* Staint., was present in greater or less abundance in all coffee plantations thruout the year, being more abundant and injurious, as usual, in the dryer sections; systematic spraying was necessary in seedbeds thruout the Island. In October and November cocoons were collected at Lares to determine the percentage of parasitism. These were taken only from a dry locality. Out of 871 cocoons 645 moths emerged and only 7 parasites, all of which were *Chrysocharis lividus* Cresson.

The coffee shade tree ant or "hormiguilla" *Myrmelachista ambigua* Forel var. *ramulorum* Wheeler, was generally present thruout the coffee growing sections but during last year and since the hurricane of 1928 has been less abundant and injurious than formerly due to the destruction of so many of the large coffee shade trees; the ants are less abundant or at least less in evidence during wet weather.

The hemispherical scale, *Saissetia hemispherica* Targ., was reported abundant and causing considerable sooty mould on coffee trees at Guayanilla during April.

A light infestation of *Pseudococcus citri* Risso, was observed during April on a small variety planting at the Station at Río Piedras.

Mothis of the coffee stem-borer, *Psychonoctua personalis* Grote, were caught at light at Cataño on April 24, 1930; Coamo Springs, April 4, 1930 and at Puerto Real, Vieques Island, on April 28–29, 1930, as well as at Aguirre, May 22, but only a few specimens atlogether. The work of the larva was not observed during the year but it was undoubtedly present in the coffee sections to some extent as usual.

Several adults of a leaf-hopper, *Cicadella coffeacola* Doz., were taken on a coffee tree at Maricao, Dec. 11, 1930 (A. G. Harley; P. W. Oman det.).

COFFEE SHADE-TREES

Glyricidia sepium (Jacq.) Stend. In June a scale, *Howardia biclavis* Comst., was noticed as abundant on a number of these shade trees in a good-sized experimental plot of coffee at the Mayagüez Station; it had been present for several years according to T. B. McClelland and had considerably interfered with the growth of the trees.

Cedro hembra, *Turpinia paniculata* Vent. A lepidopterous shoot-borer, *Hypsiphyla grandella* Zell., (a Phycitid; Heinrich det.) was

reported during June as having done considerable damage to about 4,000 young trees at Jayuya and to about 1,000 young trees recently planted at Adjuntas in June, 1931; a number of young trees were moderately infested at Lares.

CORN

The corn earworm, *Heliothis obsoleta* Fab., was without doubt generally present and injurious wherever corn was grown altho but few specific reports were received or observations made.

COTTON

The pink boll-worm, *Pectinophora gossypiella* Saund., has been for more abundant than ever before and assumed the proportions of a first-class pest of cotton. Because of a prolonged drought on the South Coast which materially reduced the yield, it is difficult to estimate with certainty the extent of the damage by the pink boll-worm but at least 15 to 20 per cent if not more of the total crop of about 10,000 acres of Sea Island Cotton must have been destroyed. Infestation was noticed in the first cotton to be picked in late December and early January and it grew progressively worse so that not more than one or two pickings could be made from many fields which developed 80, 90 and even 100 per cent infested bolls, often two or three larvae infesting a single boll. The above applies also to the cotton in the Carolina section on the North Coast which, however, was planted at about the same time as that in the South Coast. No cotton was bought after May 15 but it was the end of June before the destruction of the plants was anything like complete.

In the North-Coast cotton-growing section the infestation apparently began to appear early in May or late in April and by the end of May the infestation, tho still light, was apparently general. Since then it gradually increased in severity until by the first of July many fields showed a high percentage of infestation, the damage being fully as great as that suffered by the South-Coast crop. The 1930-crop on the North Coast became fairly generally tho lightly infested towards the end of the crop in the early fall but little loss was occasioned.

About 35 acres of cotton were grown on Vieques Island for the first time in some years; it was harvested in April and May and according to the local Agricultural Agent it was all badly infested, several fields having 100 per cent of the bolls infested and only about one picking was obtained from most of the individual plantings, each of which was small.

The cotton leaf-worm, *Alabama argillacea* Hübner, occurred in destructive outbreaks thruout the year. In the South Coast outbreaks occurred from about mid October (when early plants were large enuf) thru March. None requiring poisoning were reported for April or May altho the leaf worm was present, but especially in the former month a large percentage of the crop had already been picked or was so nearly done that growers would naturally not feel it worth while to use poison even if the insect were present in some numbers. In the North Coast a moderate outbreak occurred near Isabela during March and considerable outbreaks were reported in various places during April, May and June 1931. Considerable poison was used during July and August 1930 in the main part of the North-Coast Section, and in September an outbreak occurred at Canóvanas a little east of San Juan.

According to the local Agricultural Agent on Vieques Island no leaf worm was observed on the approximately 35 acres of cotton growing on the Island during the fall to spring of 1930–31 altho careful watch was kept for an outbreak thruout the growing season.

Stainers, *Dysdercus* spp., have been generally present and often abundant but not usually doing any undue amount of damage, altho there has been some loss from reduction in the quality of the lint. By far the most common species is *D. andreae* L. and altho *D. neglectus* Uhl. is probably frequently associated with it, but one authentic record of its occurrence was obtained. This was at Carolina from April thru June and in this case *neglectus* was apparently the dominent species present in several fields at least.

Blister mite, *Eriophyes gossypii* Banks, has been present on young to old plants in all sections thruout the growing season but not very injurious; occasional plants however are found badly infested and sometimes young plants have been badly dwarfed or even entirely killed.

The black scale, *Saissetia nigra* Neitner, was observed in a number of fields in both the North and South Sections but was not abundant except in one or two cases in the South Coast where a number of old plants were thickly encrusted and apparently considerably weakened by the attack.

The bean lace-bug, *Corythucha gossypii* Fab., was occasionally observed lightly infesting the foliage of a few plants in several places.

A leaf-hopper, *Empoasca* sp. was present in small numbers in many fields examined.

The cotton aphis, *Aphis gossypii* Glov., was present in small numbers in a number of fields.

The cotton leaf-miner, *Nepticula gossypii* Forbes and Leonard, was present, light to abundant, in many fields in the South Coast but like the previous year was not observed in the North Coast.

A scavenger caterpillar, *Pyroderces rileyi* Wlsm., was often observed working in old or decayed cotton bolls.

"Changas", *Scapteriscus vicinus* Scudd., were reported as doing considerable injury to young cotton plants at Isabela in the spring of 1931.

COWPEAS

The cowpea pod and stalk borer, *Fundella cistipennis* Dyar, was repeatedly reared from cowpeas at Río Piedras during the summer and fall.

A bean pod-borer, *Etiella zinckenella* Treit., was several times reared during the summer and fall from cowpea pods at Río Piedras.

The scavenger caterpillar, *Pyroderces rileyi* Wlsm., infesting dry cowpea stems from Vieques Island, Jan. 7, 1931. (A. S. Mills.)

CROTALARIA

The rattlebox moth, *Utethesia ornatrix* L., has been abundant and destructive as usual, at least at the lower elevation, one grower having reported only 7 tons of seed from 60 acres at Bayamón during February and March, which was only about ⅓ normal yield. Another grower at Adjuntas (about 2,000 ft. elevation) reported, however, little damage. The former grower stated that the poorest yields due to activities of the larvae were obtained from seed planted in April, May and June. Since it takes 4–5 months to mature a crop of seed this crop came off in August and September thru October and November and therefore presumably the maximum activity of the larvae would come somewhat in advance of the harvest period.

A bean pod-borer, *Maruca testulalis* Geyer, was found once at Río Piedras in March, a single larva boring within a pod.

A bean pod-borer, *Etiella zinckenella* Treit., was several times reared from *Crotalaria* pods at Río Piedras during the summer.

A gelechiid pod-borer, *Brachyachma palpigera* Wlsm., was several times found in the dry pods in the late summer and fall from Pueblo Viejo and Bayamón.

A Mycetophagid beetle, *Typhaea fumata* L., (W. S. Fisher det.) was collected—several specimens—in the pods at Pueblo Viejo, Aug. 14, 1930. Not in Wolcott's "List".

CUCUMBER AND MELONS

The melon worm, *Diaphania hyalinata* L., was observed moderately abundant in squash and cucumber at Manatí and in cucumber at Arecibo in January and February and very injurious to melon and cantaloupes near Aguadilla in May.

The melon aphis, *Aphis gossypii* Glov., was present and often injurious in several places but probably was a factor wherever cucurbiits were raised.

A leaf-hopper, *Agallia albidula* Uhler, was common on watermelon vines at Arecibo on Nov. 4, 1930 (Mills and Anderson; P. W. Oman det.). This species has apparently not been definitely before recorded from Porto Rico.

An adult of the weevil, *Lachnopus curvipes* Fab., was found on a watermelon leaf at Arecibo on November 11, 1930 (Mills and Anderson; Buchannan det.) but it probably was not feeding on this plant.

The pickle worm, *Diaphania nitidalis* Stoll, was moderately infesting a patch of cucumbers at Arecibo in March 1931; adults were reared (A. S. Mills).

A leaf beetle, *Diabrotica innuba* Fab., found on the leaves in a watermelon patch at Barceloneta, Dec. 12, 1930 (R. Faxon and A. S. Mills; H. S. Barber det.).

EGGPLANT

The leaf-tyer, *Psara perusialis* Walk., moderately infested a fair-sized patch at Río Piedras on Jan. 5 (Anderson and Mills; Heinrich det.). At the Station it was present and troublesome thruout the year.

The eggplant lace-bug, *Corythaica monacha* Stal., was generally present and injurious thruout the year. It was especially noticed as abundant at Palo Seco in August and at Río Piedras, Dorado and Humacao during January and February. The insect was also to be found in greater or less abundance thruout the Island on its favorite wild food plant, *Solanum torvum*.

Fleabeetles, *Epitrix cucumeris* Harr. and *E. parvula* Fab., were more or less abundant in several localities examined, especially during the fall and winter; more damage was done to seedlings than plants in the field.

Aphids, *Myzus persicae* Sulz. and *Aphis gossypii* Glov., were observed in small numbers at Río Piedras, Dorado, Humacao and several other places on the Island during January and February.

Adults of a coreid bug, *Corizus hyalinus* Fab., were collected from eggplant leaves at Caguas, Feb. 18, 1931 (R. Faxon and A. S. Mills; H. G. Barber det.); previously recorded here only from Río Piedras in June, 1916 as "very abundant on weeds in a garden, some feeding on tomato".

Red spiders, *Tetranychus* sp., were abundant and injurious to plants at the Station at Río Piedras during the spring of 1931.

Cut worms, *Noctuidae,* caused about 10 per cent loss of plants in the seed beds grown in the greenhouse at the Station during September and October; they were also injurious in the field to the young plants soon after transplanting.

A leaf-beetle, *Diabrotica graminea* Baly, was more or less injurious at the Station thruout the year, feeding on the flowers and deforming the fruits.

An adult of the egg-plant borer, *Baris torquata* Oliv., was found resting on a bean leaf at Río Piedras on Feb. 14, 1931 (A. S. Mills; L. L. Buchannan det.).

A leaf-hopper, *Cicadellidae,* was generally present throughout the year in small numbers at the Station at Río Piedras but doing little damage.

GRAPE

The brown aphid, *Aphis illinoisensis* Shimer (P. W. Mason det.) was observed lightly infesting a small grape arbor in the Meliá Hotel in Ponce on May 1, 1931 (E. H. Twight of Ins. Expt. Sta.).

GRASSES

The gramma Psara, *Psara phaeopteralis* Guenée, was reported as abundant and injurious near Isabela the latter part of June on St. Augustine grass; about the same time it was very abundant on the some food plant at Aguirre. The adults and larvae were also abundant during June in large patches of a weed, *Gonphrena dispersa* at El Morro in San Juan.

"Changas", *Scapteriscus vicinus* Scudd., did great injury from September 1930 thru February, 1931 to a good-sized lawn near Río Piedras, composed of two mixed grasses locally called "horquetilla", *Chloris radiata* and *C. paraguaiensis* (Pedro Osuna of Ins. Expt. Sta.).

GUAVA

The hemispherical scale, *Saissetia hemispherica* Targ. (H. Morrison det.), was reported as infesting all the fruits on one tree at Juana Díaz, March 13, 1931 (Faxon and Mills).

A West Indian fruit-fly, *Anastrepha* sp. was found breeding in guava fruits during part of the year (see discussion under these two species on page____):

MUNG BEANS *(Phaseolus aureus)*

The leaf-beetle, *Diabrotica graminea* Baly, was numerous on a small patch at the Station at Río Piedras in June, feeding on the blossoms and leaves.

OKRA

The leaf-beetle, *Diabrotica graminea* Baly, was observed moderately infecting a 1-acre planting at Trujillo Alto in March and again in July.

A leaf-hopper, *Cicadalla sirena* Stal., was lightly infesting a ½-acre patch of okra at Trujillo Alto on Mar. 10, 1931 (Anderson and Mills; P. W. Oman det.). This is the first record for okra in Porto Rico.

The hemispherical scale, *Saissetia hemispherica* Targ., was found to be lightly infesting about a 1-acre planting at Trujillo Alto on March 27 (R. Faxon and A. S. Mills; H. Morrison det.).

Aphis gossypii Glov. heavily infested the above patch on the same date (Faxon and Mills; P. W. Mason det.).

The black scale, *Saissetia oleae* Bern. (Morrison det.), was observed lightly infesting the same patch on March 10, 1931 (Anderson and Mills).

ONION

The onion thrips, *Thrips tabaci* Lind., was present as usual wherever onions are grown and often very injurious, more so of course where control measures were not well carried out and in the drier sections and periods.

PALMS

The palm aphid, *Cerataphis lantanae* Boisd., was found badly infesting a plant of *Cyrtopodium Woodfordia* in Santurce on March 4, 1931 (Faxon and Mills; H. Morrison det.).

PAPAYA

The papaya fruit-fly, *Toxotrypana curvicauda* Gerst., had been previously reported only from Mayagüez. A careful survey of many localities in the Island during the end of July and early August failed to discover infested fruits. Early in September however, it was found at Lares and later in the month a number of infested fruits

were found at this town and also in Mayagüez but at no other point in the Island. It was reported again from Lares in January and February. Also 1 out of 7 small green fruits examined in the Mayagüez market on Jan. 6 by Mr. Harley contained 6 larvae. During May and June 1931 many fruits were reported badly infested at one farm near Ponce.

The West Indian peach scale, *Aulacaspis pentagona* Targ., has been observed during the period covered in almost every place in which papayas were observed thruout the Island, often almost entirely encrusting the trunk and branches and many fruits.

Another scale, *Pseudoparlatoria ostreata* Chll., was observed as very abundant at Ponce and several other places on the South Coast in the fall and also abundant at Isabela in May. It is undoutedly widely distributed and abundant on papaya.

The bean lace-bug, *Corythucha gossypii* Fab., was observed to be scarce to fairly abundant in all stages on the leaves in several widely separated localities during July and August 1930.

PASSIFLORA

Two scale insects, *Pseudoparlatoria ostreata* Ckll., and *Howardia biclavis* Comst. (both Morrison det.), were found to be so heavily infesting eight vines at Río Piedras on July 7 that one vine had died (A. S. Mills).

A few caterpillars of *Dione vanillae* L. were observed eating the leaves of one vine at Río Piedras on July 13 (A. S. Mills).

BLACK-EYE PEA *(Vigna unguiculata)*

The cowpea pod and stalk borer, *Fundella cistipennis* Dyar was reported by E. Molinary and A. Riollano of the Ins. Dept. Agr. to have rendered worthless most of the seed on about 10 acres out of a total planting of about 25 acres at Puerto Real, Vieques Island, in February or March.

PEAS

Specimens of *Blissus leucopterus* var. *insularis* Barber, found on a garden pea plant from Vieques Island, Sept. 10, 1930 (A. S. Mills; H. G. Barber det.).

PEPPERS

A light infestation of corn earworm, *Heliothis obsoleta* Fab., was observed at Río Piedras in January or February. Larvae were also found infesting peppers offered for shipment to the States from Río Piedras in December 1930.

A stink bug, *Arvelius albopunctatus* DeG. lightly infested peppers at Corozal in January or February.

A mealy-bug, *Aleurotrachelus trachoides* (Back.) moderately infested the leaves in a 2-acre planting at Arecibo on Feb. 24, 1931 (Anderson and Mills det. G. B. Merrill).

A Pentatomid bug, *Euschistus crenator* Fab. was observed in all stages feeding on the fruits in a 2-acre planting at Arecibo on Feb. 24, 1930; about 15 per cent of the plants were affected (E. G. Anderson and A. S. Mills; H. G. Barber det.).

An adult of *Nezara viridula* L. was taken feeding on a pepper fruit at Arecibo, Feb. 24, 1931 (E. G. Anderson and A. S. Mills; Barber det.).

PIGEON PEAS

Moths of a bean pod-borer, *Etiella zinckenella* Treit., were several times reared from the pods in a planting near Río Piedras.

Heliothus virescens Fab. larvae were repeatedly found eating large holes into the green pods.

Larvae of a moth, *Brachyacma palpigera* Wlsm., were common during the summer and fall in dry pods and moths were reared from several localities. A proctotrupid parasite of the larvae, *Paralitomastix* n. sp. (Gahan det.) was found in as high as 50 per cent of the larvae in some collections made.

A legume pod-borer, *Fundella cistipennis* Dyar, was found moderately infesting a number of plants during July 1931 at Río Piedras.

A thrips, *Frankliniella (=Euthrips) insularis* Franklin, was found infesting pigeon-pea blossoms at Mayagüez, Jan. 2, 1931 (H. Morrison det.).

The weevil, *Callosobruchus chinensis* L. was found working in dry pigeon-pea pods at Río Piedras, Aug. 8, 1930 (A. S. Mills; H. S. Barber det.).

A Phalacrid beetle, *Olibrus* sp., was commonly found breeding in dry pods at Río Piedras during July and August.

An adult of *Hypothenemus* sp. near *parvus* Hopk. (Blackman det.) was found boring inside a dry pod at Río Piedras, July 15, 1930 (A. S. Mills).

The beetles, *Cathartus rectus* L., *C. advena* Watl. and *C. cassiae* Reiche (W. S. Fisher det.), were all collected from inside dry pigeon-pea pods at Bayamón, July 8, 1930 (A. S. Mills).

PINEAPPLE

The pineapple mealy-bug, *Pseudococcus brevipes* Ckll. (det. Morrison) has been generally present but apparently neither common nor injurious. This according to specimens determined by Dr. Morrison for Dr. Wolcott is not *P. citri* Risso, but is what is listed in Wolcott's "Insectae Portoricensis" p. 281 as P. *bromeliae* Bouché.

The fire ant or "hormiguilla brava", *Solenopsis geminata* Fab., has been generally present and in some cases at least doing some damage.

POTATOES (IRISH & SWEET)

The potato flea-beetle, *Epitrix cucumeris* Harr. was present thruout Jan., Feb. & March and increasing in numbers in several fields of Irish potatoes in Comerío, Adjuntas, Cidra, Caguas, and Río Piedras and especially in March did considerable injury.

The bug, *Spartocera batatas* Fab., injured experimental plots of Irish potatoes at Utuado in March; this is apparently its first record of injury to white potatoes in Porto Rico.

The spinach aphis, *Myzus persicae* Sulz., did considerable injury by the end of March to a small-patch of Irish potatoes near Río Piedras.

A leaf-beetle, *Diabrotica graminea* Baly, was fairly abundant on Irish potatoes at Comerío and Adjuntas early in March and at Cidra early in February.

The potato tuber moth, *Pthorimaea operculella* Zell, lightly infested a quantity of seed potatoes (Irish) which had been received from Prince Edward Island, Canada, and which had been stored under one of the buildings at the Station. The insect had apparently not been recorded as infesting Irish potatoes previously in Porto Rico.

The sweet potato weevil, *Cylas formicarius* Fab., was generally distributed and injurious as is usual, reports especially coming from Humacao, Carolina and Vieques Island.

The Scarabee, *Euscepes batatae* Waterh., was found in May to be heavily infesting some sweet potato tubers in Carolina received for seed purposes from Mayagüez.

The sweet potato leaf-miner, *Agromyza ipomeae* Frost, was apparently present to some extent in practically all parts of the Island but not abundant enuf to be injurious.

Leafhoppers, apparently *Empoasca* sp., were usually observed in fair numbers wherever sweet potato plantings were examined but little injury seems to have been done.

RICE

The "changa", *Scapteriscus vicinus* Scudd., was reported as destroying about 50 per cent of the young plants in a 1-acre field at Juncos during April and into May; 3 acres of rice planted in early April 1930 in the same place were finally entirely destroyed by early July.

ROSE

A mealy-bug, *Orthesia insignis* Douglas, did considerable damage to a number of rose bushes in June in a garden in Santurce.

The cottony cushion scale, *Icerya purchasi* Mask. (Morrison det.), was found lightly infesting 50 rose bushes at Santurce, Feb. 24, (J. Luciano). The first record for Porto Rico.

June beetles, *Phyllophaga* spp., were reported as injuring several rose bushes at Ponce in early May by damaging the roots while burrowing for the purpose of egg-laying.

A leaf beetle, *Metachroma antennalis* Weise, was reported as doing very considerable damage to roses at Aguirre from April on; the beetles were present in enormous numbers, eating the flowers, leaves, and bark and over 400 out of about 1,000 bushes were practically destroyed.

SUGAR CANE

The sugar-cane moth-borer, *Diatraea saccharalis* Fab., did apparently the usual amount of damage which as probably, as far as could be determined, about the same as during the previous year or two. One large Central, however, near Hormigueros at the West end of the Island, reported a very high percentage of infested cane in many fields and stated that borer was worse than during the two years previous. As usual the percentage of cane infested was somewhat higher on the South Coast than in those parts of the North Coast having a higher rainfall. This statement is based upon many canes examined in several places during the harvest period from February to May 1931. At Aguirre and one or two other localities a rather high percentage of eggs were found infested with *Trichogramma minutum* Riley, but only a few eggs masses altogether were examined. Evidences of some parasitism by *Lixophaga diatreae* Towns. were also observed in almost every locality in which cane was examined, but no counts were made to determine percentages.

White grubs, *Phyllaphaga* spp., did about the usual amount of moderate damage. Altho the adults may not have been noticeably much less numerous than during the previous year or two it is the opinion of several of the larger sugar companies that white grubs

are less injurious now than previously. The manager of a large Central near Aguadilla felt that the damage had been less this past year due to the imported toad, *Bufo marinus* L., eating the adults. Surveys in a number of cane fields in different parts of the Island showed that these toads eat large numbers of June beetles and several large cane growers feel that they have been noticeably beneficial in white grub control. The adults were scarce at lights at Aguirre early in June and entirely absent late in the month.

The "vaquita", *Diaprepes spengleri* L., caused some stripping of young cane leaves as usual; one rather severe case of this was observed in Isabela but the young cane recovered due to abundant rains following the injury.

The yellow cane aphis, *Sipha flava* Forbes, caused very considerable damage in the western end of the Island from Isabela, Moca and Aguada to Cabo Rojo, Lajas, and Guánica. This started in December and gradually increased in severity thru March but during April, abundant rains following the pronounced dry spell, the infestation ceased. Not only Japanese cane but also POJ–2725 and 2878 were affected. At Aguada in March *Cycloneda sanguinea* L. was common in infested fields but the pupae were highly infested by an undetermined Chalcid. Altho the extensive properties of the Aguirre Sugar Co. on the South Coast suffered a considerable dry spell during the winter, Mr. Herbert Osborne Jr. and others reported the aphis not as bad as during the previous year.

The sugar-cane root-caterpillar, *Perforadix sacchari* Sein, was probably present in about the usual numbers. Moths were abundantly observed in one field near Mayagüez in April among the cane on the ground just after cutting.

The sugar-cane scale, *Aspidiotus sacchari* Ckll., was generally distributed thruout variety experimental plots examined during April and May at Mayagüez, Naguabo and Guayama, the percentage of cane infested at Mayagüez being small but in the other two places about 10–12 per cent.

The pink leaf-sheath bug, *Lasiochilus divisus* Champ., was found fairly commonly and in all stages in a large experimental plot of several cane varieties examined in April near Mayagüez. Early in June adults were fairly common at light at Aguirre but late in the month were scarce.

The West Indian cane weevil, *Metamasius hemipterus* L., was probably generally present but was observed (in cane being harvested) only at Mayagüez (light infestation) in April and fairly common at Guayama.

The sugar-cane mealy bug, *Pseudococcus sacchari* Ckll., was observed more or less commonly at harvest time (February–May) in several localities on the North and South Coast and West end of the Island, but was apparently somewhat more common in the south.

The red-striped sugar-cane scale, *Pulvinaria iceryi* Guer., was found infesting the leaves of some sugar-cane plants in one of the greenhouses at the Station at Río Piedras in March.

The adults of the Scarabeid beetle, *Dyscinetus barbatus* Fab., known to attack sugar cane, were abundant at lights at Isabela for a few weeks, being first noticed about the middle of April, but became scarce the middle of May and soon after failed to appear any more.

A leaf-hopper, *Protalebra brasiliensis* De Long, listed as a minor pest of sugar cane in Porto Rico, was abundant thruout June on large patches of a weed, "margarita" or "clavelillo" (*Bidens pilosa*) on the golf course at San Juan but was scarce at the Station at Río Piedras.

The Scarabeid beetles, *Ligyrus tumulosus* Burm., were common at light early in June at Aguirre but scarce the end of the month.

SWORD BEAN (*Cannavallia* sp.)

The cowpea pod and stalk borer, *Fundella cistipennis* Dyar, was reported as moderately infesting the pods in a patch at Florida during the latter part of April.

TOBACCO

The tobacco leaf-miner, *Phthorimaea operculella* Zell., did considerable damage, more so than usual due to unusually dry weather, around Comerío and Caguas, and also in one field near Río Piedras during February, March and April.

The tobacco hornworm, *Protoparce sexta* Joh. var. *jamaicensis* Butler, was undoubtedly generally present as usual; it was reported specifically as having completely stripped the leaves from a 2-acre planting at Juncos during April; no attempt at control had been made.

The "changa", *Scapteriscus vicinus* Scudder, was generally present and more or less injurious. In the Juncos–Las Piedras tobacco section it was reported as killing about 15 per cent of the young plants in the field during November and December which is said to be about the usual amount of damage there.

Climbing cutworms, *Noctuidae*, were reported as more injurious

than usual to young plants in the Juncos–Las Piedras section, killing about 20 per cent during November and December.

Flea-beetles, *Epitrix cucumeris* Harr. and *E. parvula* Fab., were very injurious to seed-beds at the Station in September and October but present and injurious also to plants in the field during the winter. They were also generally distributed and injurious throughout the growing season (winter and spring) in the tobacco sections. Damage was reported as light during the winter to seedbeds in the Juncos–Las Piedras district. Early in May some damage was just starting to late tobacco in the field around Humacao.

TOMATO

The corn earworm, *Heliothis obsolete* Fab., was observed moderately injuring tomato fruits during January or February at both Río Piedras and Arecibo.

A plant-bug, *Phthia picta* Drury, was present in all stages and puncturing about 50 per cent of the fruits in a small patch of tomatoes at Río Piedras in January or February. A single plant at the Demonstration Farm at Mayagüez had all stages present in abundance in April, but little damage had been done.

Nezara viridula L. was observed injuring about 20 per cent of the fruits in the same garden patch at Río Piedras in December (A. S. Mills).

An adult of the bug, *Thyantor perditor* Fab., was found feeding on tomato fruit at Corozal Feb. 5, 1931 (A. S. Mills; H. G. Barber det.).

Cutworms, *Noctuidae*, caused about 10 per cent loss to plants in seed-beds in greenhouses at the Station in September and October and about 20 per cent to young plants after being set in the field.

The leaf-tyer, *Pachyzancla perusialis* Walk, was present in the field but more injurious to a number of experimental plants grown in the greenhouse thruout the year.

The potato and tomato flea-beetle, *Epitrix cucumeris* Harr., was generally present and sometimes doing considerable injury.

"Changas", *Scapteriscus vicinus* Scudd., were reported as doing considerable injury to young tomato plants at Isabela.

WEST INDIAN LAUREL *(Ficus nitida)*

The mealy-bug, *Icerya montserratensis* Riley and Howard, was observed badly infesting one or two of a number of large trees in the Plaza at Caguas in April. It was probably present during the

year since several subsequent examinations showed it to be about the same.

A thrips, *Gynaikothrips uzely* Zimm = «*Mesothrips ficorum* Marchal» was observed abundant as usual in several parts of the Island, often considerably curling the leaves.

WEST INDIAN FRUIT FLIES

One species of *Anastrepha* was generally distributed and as abundant as usual. The jobo or hog plum, *Spondias mombin,* is its most favored host and is always found infested from June to December, the period of ripe fruits. Ciruelas, *Spondias cirouella* and *S. purpurea,* were also commonly infested during their fruiting season, August thru October, but not quite so heavily. Certain varieties of native and imported mangos were commonly infested from April thru June; certain other varieties, heretofore always reputed to be immune, have remained so, as far as observations could determine. It also breeds to some extent in guavas.

Another species has been found breeding commonly in pomarrosa, *Jambos Jambos,* during April and May, apparently being its favorite foodplant. Bitter almond, *Terminalia cattapa,* was also found infested during April thru August 1931 but only in a comparatively few fruits at Río Piedras and Arecibo. This is commonly found in guavas. (F. Seín, Jr.)

MISCELLANEOUS RECORDS

The following records are from interceptions made by the United States Plant Quarantine and Control Administration office in San Juan during the fiscal year. Altho not primarily of economic importance they constitute in most cases new or interesting records for the Island:

A scale, *Conchaspis angraeci* Ckll. (Morrison det.), heavily infesting the branches of an undetermined tree at Río Piedras, July 7, 1930 (A. S. Mills). Listed previously only on vanilla at Mayagüez (1917) and ornamental croton at Mameyes (1912).

A predacens bug, *Coreocoris fusca* Thunberg (H. G. Barber det.) adults and nymphal instars on a weed, Bayamón, Aug. 8, 1930 (A. S. Mills). Not in Wolcott's "List".

Several adults of a Cynipid, *Eucoila (Hexamerocera) hookeri* (L. H. Weld det.) were reared from jobo fruits infested with *Anastrepha* sp. at Mayagüez, Sept. 21, 1930 (A. G. Harley). Not in Wolcott's "List".

An adult of *Opius anastrephae* Vier. (A. B. Gahan det.) also reared from jobo, *Spondias lutea,* as above.

An ant, *Tapinome littorale* Wheeler (W. M. Mann det.) in dry leaves at Aguas Buenas near the mouth of the caves, Oct. 1930 (A. S. Mills).

An Anthomyid fly, *Atherigona excisa* Thomson (Aldrich det.) reared from larvae in decayed areas in string-bean pods from Isabela, collected Sept. 20, 1930 (Faxon and Mills); also reared from 7 larvae in tomatoes for export, Borinquen (near Aguadilla) Jan. 12, 1931. Not in either Wolcott's or Curran's "Lists".

The vinegar fly, *Drosophila ampelophila* L. (C. T. Green det.) reared in numbers from string bean pods as above; also 3 adults on a banana leaf Maricao, Dec. 11, 1930 (A. G. Harley). Not previously reported from Porto Rico.

The Nitidulid beetles, *Stelidota geminata* Say and *Scymnillodes gilvifrons* Chpn. (E. A. Chapin det.), were found in a decayed area in an orange at Barceloneta, Dec. 12, 1930 (Faxon and Mills). The former is little known in Porto Rico and the latter is not in Wolcott's "List".

Nitidulid *Haptonchus luteolus* Er. (Chapin det.), adults were found in decayed fruits of *Inga laurina* at Santurce, Dec. 19, 1930 (E. G. Anderson and A. S. Mills).

A large nymph of an earwig, *Anisolabis annulipes* Lucas (A. N. Caudell det.) was taken in the above fruits also.

An Ortalid fly, *Euxesta stigmatias* Loew. (Aldrich det.) was reared from an ear of corn Sept. 12, 1930 from Río Piedras (A. S. Mills). The locality is new for Porto Rico.

A Reduvid bug, *Zelus longipes* L. (H. S. Barber det.) collected on a pepper leaf Nov. 4, 1930, at Arecibo (A. S. Mills).

A Trypetid fly, *Xanthaciura phoenicura* (Aldrich det.) on a grapefruit leaf at Añasco, Nov. 5, 1930 (A. G. Harley). Not previously reported from Porto Rico.

A Coreid bug, *Charicsterus gracilicornis* Stal (H. G. Barber det.) found resting on a grapefruit leaf at Añasco Nov. 5, 1930 (A. G. Harley).

A Calliphorid fly, *Morellia violacea* Fab. (Aldrich det.), 3 adults collected from orange foliage, Maricao, Dec. 18, 1930 (A. G. Harley). Not previously reported from Porto Rico.

A Trypetid fly, *Euaresta melanogaster* Lw. (Aldrich det.) swept from grass in an orange grove, Maricao, Dec. 26, 1930 (A. G. Harley). Little known in Porto Rico.

A Psocid, *Embidopsocus lutens* Hagen (Caudell det.). Numerous

adults and nymphs in cereal in a glass jar, San Juan, Dec. 25, 1930 (Faxon and Mills).

An adult of the butterfly, *Lycaena cassius* Cramer (Shaus det.) on a bean leaf, Manatí, Jan. 16, 1931 (Anderson and Mills). Recorded only once, from Camuy.

An earwig, *Psalis americana* var. *gagathina* Burm. (Caudell det.), 1 female in decayed trunk of banana, Maricao, Jan. 24, 1931 (Harley, Faxon and Mills). A new locality record.

A Nitidulid beetle, *Lobiopa insularis* Cast. (Böving det.) young larvae in jobo fruits, Río Piedras, Jan. 26, 1931 (Faxon and Mills).

A Stratiomyd fly, *Neorondania chalybea* Weid. (C. T. Greene det.) taken on a potato leaf, Cidra, Feb. 18, 1931 (Faxon and Mills). Previously listed only from Río Piedras.

A Coccinellid beetle, *Cycloneda limbifer* Csy. (E. A. Chapin det.), adult on eggplant, Caguas, Feb. 13, 1931 (Faxon and Mills). Not listed previously from Porto Rico.

A Coccinellid, *Neda ferruginea* Oliv. (E. A. Chapin det.), adult on cotton leaf, Ponce, Mar. 13, 1931. (Faxon and Mills).

A Coccinellid, *Scymmus loewii* Muls. (E. A. Chapin det.), several adults in a box of peppers from Vega Baja, Mar. 7, 1931 (Faxon and Mills).

A NEW FROG FROM PUERTO RICO

CHAPMAN GRANT, Major, United States Army.

My collection of over 6,000 specimens collected in nineteen months in and near Puerto Rico contains 21 species or subspecies and one genus not listed in the last herpetology of this Island. The present is the most elusive species discovered. It may be called:

Eleutherodactylus cooki sp. nov.

Type—From Pandura Mountains, Southeastern Puerto Rico, collected by Chapman Grant, January 24, 1932. Chapman Grant collection. No. 4108, adult.

Range—Known only from type locality.

Diagnosis—Distinguished from the other salentia of Puerto Rico by having vent to heel as long as vent to snout; toe discs twice as wide as long and plain brown back. Thighs and venter only slightly and finely rugose. Eyes very large. Throat sometimes canary yellow. Voice distinct. Life history distinct.

Description of type—Habitus slender, head wider than body, eyes large and protruding; limbs weak, relatively long, heels widely overlapping when thighs are placed at right angles to body; heel reaches snout when extended forward. Vomerine teeth in slightly curved oblique series, behind and within the choanae, the distance between series about half the length of one series. Tongue large, oval, notched behind. Nostrils near tip of snout, prominent. Tympanum distinct, its width slightly less than half the width of eye.

Eye very large, width equal to eye to tip of snout, appears black but when a living specimen is examined in sunlight the iris is black, finely reticulated with gold. The edge of the eyelid is white, making a narrow white line around the eye. The eye protrudes so far that the impression of mouse ears is given. Unfortunately, the eyes shrink somewhat in alcohol. The four fingers free with discs twice as wide as long; tubercles prominent, the five toes free with similar discs. Skin smooth below except for slightly rugose venter, lower surface of thighs slightly rugose; above smooth except for a few scattered excrescences or warts. Color in life, light brown above, darker at head, legs lighter, underside nearly white, but minutely and evenly specked with dark. No markings.

Measurements—Snout to vent 37 mm.; vent to heel 37 mm.; width

of head 15 mm.; snout to posterior edge of tympanum 14 mm.; leg from vent 60 mm.; foreleg from axilla 26 mm.; tibia 18 mm.; hind foot 23 mm.

Voice—Four more specimens were taken alive February 28th and fourteen more on March 27th. They were kept separate to hear a "pure culture" vocalization. *E. richmondi* occurs in small numbers in the same locality, so it was thought important to check positively on the song. The four specimens were kept separate over night and sang. There is not the slightest resemblance to the voice of any of the other *Eleutherodactyls* of Puerto Rico. One adult was seen in the act of singing. The body was raised on front feet at a forty-five degree angle, hindquarters on a boulder, throat distended and vibrating. The note is repeated six or seven times and cannot be reproduced by a syllable or on the piano. The nearest is pe-pe-pe-pe-pe-pe, one-sixteenth notes in second A treble. The note has a liquid sound and can best be imitated by whistling.

On March 27, fourteen specimens were taken. Although the weather conditions were similar to February 28th as to dryness, the temperature was probably slightly higher. The amount of singing had greatly increased, probably due to breeding. More frogs were seen in the "open", i.e., on the perpendicular faces of the rocks, and fewer hidden in cracks. The yellow throats prodominated. Probably they were the males, singing and in search of females.

Aside from an entirely different voice, this species differs from *E. portoricensis* in the following details:

	E. portoricensis	*E. cooki*
Heel to vent	less than vent to snout	equal or longer than vent to snout
Rugosity of belly and thighs	coarse	fine
Digit pads	slightly wider than long	over twice as wide as long
Width of ear	over half width of eye	less than half width of eye
Width of eye	less than eye to snout. Appears normal	equals eye to snout. So large as to resemble mouse ears.
Iris	lighter above pupil. Brassy	all same color, appearing black
Back	variously colored or marked	one color, no markings
Throat	never bright yellow	sometimes bright yellow
Habitat	above ground	deep caves
Song	co-qui' (accented)	pe-pe-pe-pe-pe-(melodious)
Underside	dark	nearly white

Life history:

An eyed egg is 6 mm. in diameter; uneyed, from 4 mm. up. They are covered with a thin layer of viscous gelatin and pasted together in a single layer in a clump of about twenty-five on the perpendicular face of a damp rough boulder in the semi-darkness of the chasms. When lifting the eggs from the granite, by getting hold of two or three, the whole clutch may peel off as a unit. At each clutch seen, a frog was sitting next to the eggs, facing away from them.

Two clutches of *E. cooki* eggs were allowed to hatch in a vial containing a rag kept wet for moisture. A similar vial contained *E. portoricensis* eggs. Upon hatching, *E. portoricensis* measured 6 mm. snout to vent and *E. cooki* measured over 8 mm. Newly hatched *E. portoricensis* is dark brown with scattered white dots, larger and fewer above and numerous and small below. Newly hatched *E. cooki* is much larger, light olive with complicated dorsal markings of darker brown; rings around fore and hind legs, wide band joining eyes, etc.

Variation: About half of the specimens have canary yellow on the throat, some have solid yellow or yellow blotches, the others light brown. Unfortunately, the yellow fades in twelve hours in alcohol. In smaller specimens, the yellow is in patches. On large specimens, the throat and extending back to just behind the front legs is a clear canary yellow. The only sign of pattern above is a faint light band joining the eyes, seen only at certain times. Some of the largest males (?) have yellow on the sides, where the thighs usually cover, and yellow tinges on the thighs. The white ring around the eye is very noticeable in living specimens. The eye is black and gold and the same color above as below the horizontal pupil. The nictitating membrane closes from the rear forward and completely covers the eye at will.

Remarks—There was an infestation of small red ticks on the legs and sides of these frogs.

This is the most romantic species on the Island. It inhabits the "guajonales" of the Pandura Mountains, and is known locally as a "guajone". A "guajonal" is a place where wild bamboo grows, but here used to designate a mountain gorge tumbled full of granite boulders from bungalow to grand piano size. One can hear from the surface a most melodious note coming from the depths, a sweet liquid pe-pe-pe-pe-pe-pe-pe resounds from the gloomy caves, echoes, re-echoes and is repeated by other "guajones". "The 'guajone' is only a voice. No one has ever seen one", the natives say. In the day time, with

a flash light, one can crawl down one, two, three tiers of jumbled boulders to the hidden stream bed in disintegrating granite. The "guajones" sing, but it is impossible to locate them by ear. The flashlight and a slender twig will serve to locate and dislodge them from deep cracks less than half an inch wide under the husks of exfoliating granite, or from the damp earth where earth and boulder meet. It took me three all-day trips to secure one specimen. It was only on the third trip that I discovered their hiding places and then several escaped after being pried out. One might as well try to bribe a mountaineer to catch a ghost as a "guajone". I tried it; money is no object.

The frog is a poor swimmer. It does not go into water of its own accord. When placed in water, it gets out as quickly as it can. Its movements in water are in contrast to its agility on boulders.

Specimens taken—19.

Named in honor of Dr. Melville T. Cook

NOTE: Since going to press the number of specimens taken has increased to 66; some measuring as much as 54 mm. snout to vent.

THE GENUS ALSOPHIS IN THE PUERTO RICO AREA

CHAPMAN GRANT, Major, United States Army.

The genus *Alsophis* splits into two distinct species in the Puerto Rico region. The first has seventeen scale rows, at mid-body, and is known only from Puerto Rico, Caja de Muertos, Desecheo and Mona Islands. The second, with nineteen rows, is known only from the Virgin Islands, Culebra and Pinero Islands. Pinero is less than a half mile from Medio Mundo Island, which in turn is separated only by a narrower channel from Puerto Rico. One would expect to find *A. portoricensis* instead of *A antillensis* so close to the mainland and so far from Culebra or Vieques. This is another anomaly of distribution.

Stejneger and Schmidt lay emphasis on pattern in distinguishing the species of this genus. Schmidt split the Mona from the Puerto Rican form principally because of pattern. One can pick an almost typical form of any of these patterns from my series from any island; that is, the patterns overlap—are not wholly specific. Nevertheless, the patterns shown by Stejneger and Schmidt hold in the majority of cases from Mona, but specimens from Caja de Muertos average between the Mona, the Puerto Rico and the Culebra patterns.

Specimens from Culebra are reticulated above with clear white bellies; one with a continuous stripe on third, fourth, and fifth rows and with black bordered belly scales. These overlap the pattern of *A. portoricensis*. An *A. portoricensis* shows hardly any black on the belly, but with elaborate striping and variegated markings, thus at once bridging all three species. Caja de Muertos specimens show nearly perfect patterns of the three species. The Pinero specimens seemed at first to be slightly aberrant *A. portoricensis*, but they were *A. antillensis.*

Nevertheless, my quart bottles full of specimens can be sorted correctly using Stejneger & Schmidt's text figures for a guide, except for the Caja de Muertos specimens, which are about equally divided between the three patterns. It seems wise to indorse the division as it now stands, but *A. variegatus* is very close indeed to *A. portoricensis.* A large series from Desecheo Island, which lies between Mona and Puerto Rico, would be interesting. Schmidt was hardly warranted in attributing *A. antillensis* to Puerto Rico on the strength of two specimens, one having seventeen rows.

Schmidt (p. 141) states: "The identification of the two specimens collected by me at Coamo Springs as this species (*A. antillensis*) removes the element of geographical distinctness from the allied *A. portoricensis*. The male specimen has only seventeen scale rows and so might be identified with *A. portoricensis*, were it not that the coloration of both specimens is nearly typical of *A. antillensis*." The species do seem to be geographically distinct. This opinion is based on eighty-four specimens, all in my collection. It will be noted that in the "table", characters considered specific by other writers have been omitted. A study of my series makes this necessary, as no color or pattern is wholly specific. Without correct geographical data, it would be difficult to classify correctly all specimens.

As stated above, Culebra specimens have "clear white bellies" in alcohol. In life the chin and the anterior third or less of the belly is a bright straw yellow. This color was not seen in this species from other islands.

Table showing the specific characters selected by different writers	Seventeen scale rows at midbody				Nineteen rows at midbody	
	A. variegatus		*A. portoricensis*		*A. antillensis*	
	Specimens	Characters	Specimens	Characters	Specimens	Characters
Stejneger "The Herpetology of Porto Rico" U. S. N. M. 1904	38 specimens from Mona studied but attributed to *portoricensis*. None in U. S. N. M. collection		38 Mona 1 Desecheo 4 Porto Rico (Only 3 in U. S. N.M. collection)	No distinctive color on 5th scale row	5 Culebra 3 Vieques 22 St. Thomas 4 Virgin Ids. (Only 7 in U. S. N. M. collection)	Every 2nd or 3rd scale of 5th row particolored
Schmidt Scientific Survey N. Y. Acad. Sci. 1928	3 Mona	No reticulation. No black border to ventrals. Reduces to 15 rows.	5 Porto Rico and Caja de Muertos and "notes on 13"	Reticulated. Black border Reduces on ventrals to 13 or 14 and rarely 15 rows	None	Row of black spots on 5th row
Grant The entire series of 82 is in the Grant collection	28 Mona	Usually variegated Mona	8 Porto Rico 4 Caja de Muertos	Usually reticulated. Porto Rico and Caja de Muertos	35 Culebra 7 Pinero 2 Dog Island	Usually specked. Culebra and Pinero

A REDESCRIPTION OF *AMPHISBAENA CAECA* WITH A DISCUSSION OF ITS RELATIONSHIP TO *A. BAKERI*

CHAPMAN GRANT, Major, United States Army.

Stejneger, 1904, redescribed *A. caeca,* using a series of 19. Schmidt, 1928, studied a series of 18 and quotes Stejneger verbatim. In my series of 100, I find a sufficient difference from the description to make it worthwhile to rewrite.

The blind legless lizard of Puerto Rico is well known to the country people who turn it up with the plow or find it under stones or logs. They fancy it bears a strong resemblance to an earth worm or the blind snake, *Typhlops.* The generic name *Amphisbaena* comes from the Greek, meaning a snake able to move in either direction. The specific name *caeca* means blind.

The species was described by Cuvier in 1829.

Type locality: Not known.

Distribution: Confined to Puerto Rico where it had been recorded from Aibonito, Bayamón, Catalina Plantation, Lares, Luquillo, Mayagüez, Río Piedras and Utuado. I have taken it in addition at Humacao, Maricao, Cialitos and Juana Diaz, thus considerably increasing its known range.

Diagnosis: An Amphisbaena with 225–235 body rings, usually one temporal scute, 18 or 19 rings on tail.

Squamation based on 100 specimens:

Rostral small, triangular, the portion visible above short, about equalling the suture between the nasals; prefrontals long, suture generally longer than suture between frontals. If not measured prefrontal suture looks much longer due to an optical illusion. Suture between prefrontals or frontals about four to five times as long as the nasal suture; ocular moderate, quadrangular, smaller than either the postocular or the third supralabial. A well developed quadrangular or roughly triangular temporal between and behind the latter two and slightly smaller than the ocular. Eye faintly visible through ocular. A pair of occipitals, broader than long, more often in contact than separated behind the frontals. Three supralabials, the second as long as the other two together. Three lower labials, the second longer than the other two together. Mental followed by a single (50 per cent) or longitudinally creased (40 per cent) or a pair (10 per cent) of post mentals, followed invariably by three postgenials,

followed by four, rarely three, (7 per cent) scales of the first body ring. Below the second and third lower labials, a large malar shield; usually (85 per cent) from 225 to 235 rings on the body and 18 or 19 on the tail. At about the 100th body ring 16 (rarely 14 or 18) rows above the lateral line and 18 (rarely 16 or 20) below. Usually (66 per cent) 2 more rows below lateral line than above, sometimes (33 per cent) equal, but never more above than below. The segments of each ring longer than broad on the back, broader than long on the under side. The two abdominal rows distinctly flat and broad. Anal shields usually and normally 6; preanal pores normally 4. Color: flesh color, with a squarish brown spot, darkest on the back, occupying the middle of each segment, these spots being usually (80 per cent) absent on many of the ventral segments on the posterior half of the body and frequently (50 per cent) absent on the throat in a small spot leaving these areas light flesh color.

When the brown spots are not absent, the underside is a uniform color (20 per cent). I must take exception to Stejneger "... a large median postmental, twice as long as broad". In my specimens, I find it 1½ to 1⅓. Apparently more nearly quadrangular than in *A. bakeri*, judging from the Fig. 136.

Remarks: Stejneger, 1904, Figs. 128, 130 are unusual in that they show a decidedly rectangular temporal. Only very rarely is the temporal in the form of an elongated triangle, the point reaching the angle of the mouth as shown in Stejneger, Fig. 132. This is caused by the fusing of the temporal with a body ring scale. I have specimens with these scales fused on one side only, the other side being normal. The most frequent form of temporal seen is two sharp angles and a rounded end. Stejneger Figs. 128, 130, copied by Schmidt, 1928, Fig. 36, shows four lower labials, but their descriptions do not mention the occurrence of four. I have but one specimen with four lower labials. Stejneger Figs. 127, 129 shows the nasal suture contained 4 and 5 times respectively in the prefrontal suture instead of "... one-fifth or less". I find it 4½ and rarely 5 times. This tends to lessen the difference between it and the squamation of *A. bakeri*.

Stejneger shows 5 scales following the 3 postgenials in *A. bakeri*. A letter from Miss Cochran states that two of their three specimens have these 5 scales. In my specimens of *A. caeca* from the eastern third of the Island, the uniform 3 postgenials are followed by 4 scales or by 3 in 3 cases. This constitutes an important distinction between *A. bakeri* and *A. caeca* and would tend to show variation away from *A. bakeri*.

Two specimens taken from the vicinity of Juana Díaz are remark-

able in having a low number of scales around the body, namely 14 above the lateral line and 14 and 16 respectively below it and 230 and 226 body rings respectively. The number of rings is average for *caeca,* but less than *A. bakeri;* the low number of scales is divergent from either species. One specimen has five scales following the postgenial which ties it to *A. bakeri,* and one lacks a temporal on one side—a specific point of *A. bakeri.* My opinion is that *caeca* runs truer to form on the eastern part of the island and varies on the western. The specific validity of *A. bakeri* seems dubious.

THE LARGE AMEIVAS OF THE PUERTO RICO REGION WITH ONE NEW SPECIES

CHAPMAN GRANT, Major, United States Army.

The *Ameivas* of Puerto Rico and the adjacent islands and keys have a general superficial resemblance. The fact that most species are hatched with definite markings which change greatly with growth, going through several phases or combinations of colors and markings, makes it necessary to have fairly large series to determine specific values. Evidently earlier writers have not had sufficient series or the following interesting facts would have come to their attention.

Beginning on Mona, there is a gray species, *A. alboguttata,* which retains its small dorsal dots through life and has a low number of femoral pores and indistinct or no dorsolateral lines, which if present begin at the neck. Next east lies Puerto Rico, with a brown species, *A. exsul,* which loses its dorsal dots with age, has a higher number of femoral pores and distinct dorsolateral white lines beginning at the eye. This line fades or disappears with age. On Diablo Island, or key, further to the east, there is a black species with bright blue ventral coloration and side marking, *A. birdorum,* which retains its large dorsal dots through life and has a low number of femoral pores like the form on Mona. Its dorsolateral white lines fade or disappear early in life. There are other constant and minor differences which the following tables help to bring out:

	Number of femoral pores expressed in per cent								
Number of pores	11	12	13	14	15	16	17	18	
A. alboguttata	1	10	37	38	14	0	0	0	%
A. birdorum	0	18	21	31	27	1	0	0	%
A. exsul	0	1	5	17	29	28	12	5	%

The above table separates the Mona and Diablo forms into one group of low pore counts, contrasted with the Puerto Rico form, with a high pore count. The same table expressed in numbers of femora bearing a specified number of pores brings out the same fact.

	Number of legs having 11 to 19 pores								
Number of pores	11	12	13	14	15	16	17	18	19
A. alboguttata—legs 117	2	12	44	45	14	0	0	0	0
A. birdorum—legs 80	0	15	17	25	22	1	0	0	0
A. exsul—legs 310	0	3	15	46	88	86	49	21	4

The following table brings out specific color and pattern differences and serves better than a key.

Ameiva	*A. alboguttata*	*A. birdorum*	*A. exsul*
Dorsolateral lines begin at	Shoulder	Ear	eye
Dorsolateral lines sometimes absent in young	Yes	No	No
Dorsolateral lines clearcut in young	No	Yes	Yes
General color of back	Gray	Black	Brown
Dorsal dots persist through life	Yes	Yes	No
Dorsal dots begin at	Neck	Shoulder	Shoulder
Size of dorsal dots	Small	Large	Very small
Median light band present	Seldom	No	Yes
Median light band if present commences at	Shoulder	No	Head
Black bands central to dorsolateral lines present at least in young	No	Entire back black	Yes
Black bands lateral to dorsolateral lines usually continuous to middle age	Yes	Yes	No
Black bands lateral to dorsolateral lines break in to widely separated rhombs in adults	No	No	Yes
Lateral dots tend to form vertical stripes	No	Yes	Yes
White line axilla to groin occasional	Yes	No	Yes
Color of underside	White or light blue	Dark blue	White or light blue
Color of chin of large specimens	Red	Purple	Lavendar
Usual number of anal plates	5	3	3
Average number of femoral pores	13.2	13.8	15.3

Stejneger (1904) gives an excellent description of *A. exsul* and *A. alboguttata*. His pore counts tabulated are as follows, according to percentages:

Pores	12	13	14	15	16	17	18
A. alboguttata, 16 sp	81			19	0	0	0
A. exsul, 67 sp	5	1	12	37	27	12	6

This is interesting as it gives practically an identical distribution found in my larger series. He states, "The main differences (between *A. exsul* and *A. alboguttata*) seems to be one of coloration". He gives a minute color description but his series from Mona was not sufficient for him to detect specific differences in markings. He points out that *A. alboguttata* has five anal plates but his material was not sufficient for him to speak with finality.

Schmidt (1928) states: "*A. alboguttata* is extremely close to *A. exsul*, but may be distinguished by the more spotted dorsum. The femoral pores in 40 specimens average 13.2, in 40 *A. exsul*, the average is 15.3. . . ."

His figure, "35 *A. alboguttata* A.M.N.H. 14003", is misleading. In fact, it could be identified as a specimen of *A. exsul*. In my 60 specimens of *A. alboguttata*, not one has the dorsolateral line beginning on the superciliary ridge or has these lines clear-cut. Not one has a median light stripe showing on the neck, and extremely few have any indication of a light stripe, even on the back. Not one has the same color below as above the dorsolateral line. All have black below it. These features in his illustration are all specifically absent in *A. alboguttata* and specifically present in other species, except the absence of the black line below the dorsolateral white line, which is present in all of my total series of 341 specimens of this group of the genus taken from some of the Virgin Islands and keys as well as the Puerto Rico region.

Consolidating the averages of the pore counts, we have:

	A. alboguttata		*A. exsul*		*A. birdorum*	
Stejneger	16 sp.	13.3	67 sp.	15.4		
Schmidt	40 sp.	13.2	40 sp.	15.3		
Grant	60 sp.	13.3	157 sp.	15.3	43 sp.	13.8
Total	116 sp.	13.2	264 sp.	15.3	43 sp.	13.8

Barbour, in Zoologica, 1930, Vol. XI No. 4, p. 102, gives the distribution of *A. exsul* as follows: "St. Thomas, Water Island, St. John, Vieques, Anguilla, St. Croix, and Puerto Rico. Now exterminated on St. Thomas. I have always doubted the St. Croiz record." To this list may be added: all islets around Puerto Rico and Culebra. It is very scarce on Vieques. In the Virgin Islands: Numerous on St. Thomas; strangely not seen on Buck Island of St. Thomas, or on St. Croix or Buck Island of St. Croix; on St. John taken only at Crum Bay; taken on St. James and Little St. James, but not seen on Dog Island, or Congo Key. Taken on Lovango key. West records it on St. Croix in 1793.

Ameiva birdorum, sp. nov.

Type:—From Diablo key off Fajardo, Puerto Rico, collected by Chapman Grant, January 21, 1932. Chapman Grant collection, No. 4073, adult.

Range:—Known only from type locality. Diablo key is only about ten acres in extent.

Diagnosis:—Distinguished from other *Ameivas* of the Puerto Rico region by its black back, blue undersides and low femoral pore count, averaging 13.8.

Description of Type:—Squamation similar to *A. alboguttata*, almost black above, save neck and shoulders, which are deep olive brown; spotted coarsely from behind shoulders nearly to end of tail with yellowish spots covering about 20 granules. Forelegs black, hind legs black, spotted with yellow and blue. No trace of dorsolateral lines. Sides jet black sparsely spotted with coarse blue dots, spaced in vertical rows as continuation of about every third row of abdominal scales. Underside: Chin purple, creases of neck flesh color; chest and 4 central rows of abdominal scales clear blue, thence laterally alternating black and blue. Vent and stripe on ventral side of fore and hind legs flesh color. Tail like belly but deep blue. Soles of feet dark.

Variations:—A recently regenerated tail is striped longitudinally. The young bear the dorsolateral white lines, which disappear early. A specimen of 60 mm. snout to vent has a remnant of stripes from vicinity of ears to sacrum. At 80 mm. the stripe is practically invisible. The coloration and markings are very constant as in *A. alboguttata*.

Measurement of type in mm.

Total length	305
Snout to vent	90
Snout to center of ear	24
Width of head at ears	12
Fore leg from axilla	34
Hind leg from groin	65
Tail	215

Remarks: The species is numerous. No specimens larger than the type were seen.

Specimens taken: 43.

Named in honor of the family of Bird of Fajardo. Their courtesy and hospitality have done much toward developing the scientific knowledge of northeastern Puerto Rico and the Cordillera keys.

HERPETOLOGICAL NOTES FROM THE PUERTO RICO AREA

CHAPMAN GRANT, Major, United States Army.

Hemidactylus

The last number of this journal contained an article, "The Hemidactyls of the Puerto Rico Region". It was remarked that *H. brookii* utters a squeak when caught. Miss Adrienne Serrano of Vieques was requested to observe whether *H. mabouia* also squeaks. Under date of April 15, 1932 she states: "The salamandras are very swift and squeak when they are caught, as a sign of protest. They try to protect themselves when pursued by hiding in cracks or the joints of the boards."

Miss Serrano's statement covers an interesting point. *H. brookii* favors stone or masonry exclusively in my experience, whereas *H. mabouia* is found inside of frame houses. I have also taken them under banana sheaths on St. John, which I here add to its range, having recently taken twenty-one specimens there, five on St. Thomas, and one on Water Island—a total of 101 *H. brookii* and 92 *H. mabouia*, all agreeing with the descriptions in the above mentioned article.

It is interesting to note that West, writing in 1793 on the reptiles of St. Croix, says *Thecadactylus rapicaudus*, a large gecko, "screams ugly when being caught".

The reason that collections do not contain more specimens of *Hemidactyls* is the old story that nocturnal species are usually poorly represented in collections, whether of birds or reptiles. I quote Alexander Wetmore in this statement.

Ameiva eleanorae sp. nov.

The subspecies *Ameiva wetmorei eleanorae*, described on page 48 of the last Journal, may be given full specific value for the following reason. An unexpected difference develops in counting the femoral pores. The original description of *A. wetmorei* gives; "13 or 14 femoral pores". This agrees with my findings of 13.3 for *wetmorei* and 12.0 for *eleanorae*. It is believed this difference is sufficient to give the form full specific rank.

Pores on 39 legs	11	12	13	14	15	Av.
A. wetmorei	0	8	15	13	3	13.3
A. *eleanorae*	10	19	10	0	0	12.0

Sphaerodactylus

The last number of the Journal contains an article *"Sphaerodactylus grandisquamis, A. Valid Species"*. In this is mentioned the similarity between *S. macrolepis* from St. Croix and *S. danforthi* described in the July 1931 number of this Journal from Culebra and found also on Vieques. Since then I have taken of what would appear to be *S. macrolepis* 4 specimens from Water Island, 2 from Little St. James, 22 from St. John, and 6 from Congo Key. These have not yet been worked up in detail, but since not a single redhead male appears in this series of 34, it strengthens the full specific validity of *S. danforthi.*

The last issue contained a chart for determining the Sphaerodactyls of the Puerto Rico Region. The usefulness of this chart has been shown by the addition, since its issue, of 738 specimens of the various species which all fit into the chart. A total of 1783 specimens.

Mabuya semitaeniatus

This species was reestablished in an article in the July 1931 number of this Journal on the strength of 35 specimens from Mona and 27 from Culebra. The evidence has since been greatly strengthened by securing 21 additional specimens from Mona, 60 from Culebra and 6 from Buck Island, St. Thomas, all agreeing perfectly with *M. semitaeniatus.* Two more specimens of *M. sloanii,* one from Puerto Rico and one from Hicacos Island, both typical, add to the evidence. It seems that *M. sloanii* is restricted to Puerto Rico. The total series studied numbers 149 specimens of *M. semitaeniatus* and 8 of *M. sloanii.* The favorite hiding place of *M. semitaeniatus* is in dense clumps of *Opuntia Dillenii* (Ker-Gawl.) Haw., and not *O. repens* Bello as stated in the July number. I am indebted to Mr. J. M. Ortiz of Culebra and Mr. Juan Ferran of Mona for most of these specimens.

Anolis roosevelti

The magnificent giant *Anolis* described in the July 1931 number of this Journal was the only specimen I had ever seen until recently when Mr. J. M. Ortiz sent another fine specimen. Comparing these

two with my series of 52 *Anolis cuvieri* the difference is seen to be great. An outstanding difference was overlooked which should have been included in the diagnosis; i.e., loreal area decidedly sloping in *A. roosevelti* and vertical in *A. cuvieri*. The tail fin is always deeply scalloped distally between rays in *A. cuvieri* and straight in *A. roosevelti*. The fin is much higher in the latter, the animal is 10 per cent larger and the color is gray—not green or brown as in *A. cuvieri*.

Apparently the young of *A. cuvieri* has never been recorded. My collection contains numerous small examples, about 80 mm. snout to vent. The average adult is about 135. The young has the head larger in proportion—contained less than three times in snout-to-vent, whereas the adult is contained more than three times. Aside from these proportional differences, the young is a replica of the parents and in no way resembles *A. evermanni*, of which specimens nearly as large as these young *A. cuvieri* are common.

Leptodactylus pentadactylus

The Report of the Puerto Rico Agricultural Experiment Station, Mayagüez, October 1930, p. 4, states: "During the year a dozen frogs (*Leptodactylus pentadactylus*) were introduced from Dominica, where they are known as "mountain chicken". They have been released near Mayagüez in the hope that they will serve as destroyers of insects and also prove valuable as food product."

T. B. McClelland, director of the station, wrote under date of April 14, 1931: "Up to the present time, we have not retrieved any specimens of this frog, though the people who live along the Cartagena Lagoon, where these were turned loose, say that they hear them."

Dr. Stuart Danforth conducted me on December 28, 1931 to the Cartagena Lagoon. We waited at the edge of the lagoon until well after dark but heard only *Bufo marinus* and concluded that this is what the natives referred to since the introduction of this toad is a comparatively recent occurrence (1920).

It might have been better to introduce this frog in a situation more nearly resembling its native habitat. Another attempt should be made and a larger number of specimens liberated.

It seems strange that the voice of *Bufo marinus* is not more frequently heard, although the toads are legion. The first time I heard it was from a military camp at Juncos after a year's residence on the Island. Shortly after dark a distant (?) noise started, which at

first we attributed to a motorcycle, and later, when it seemed to remain stationary, we variously analyzed it as a feed chopper on one of the numerous dairies or an air drill in a quarry some two miles away. The noise started about dark and suddenly stopped shortly before daylight. A week later we camped in the same place. Captain Saulnier stepped out of the camp about daylight and then realized that the noise was nearby. A week later we heard the noise again near Cataño. A flashlight showed the author to be *Bufo marinus.*

The toad stands with the membrane under the chin vibrating but not distended; suddenly the vibration ceases; the throat and chest are moderately distended in a sweeping curve from the jaw to belly, to a size about equal to the head. The skin vibrates and a resonant sound is produced: "ku-ku-ku". The notes are slower than a trill and faster than one can enunciate them. These notes were made in November during very rainy weather and near semipermanent water.

Anolis poncensis, A. pulchellus and A. krugi

Stejneger shows two classes of markings, on *Anolis poncensis,* one in the extremely dry, hot and almost grassless environment, and the other amid greener surroundings. All *A. poncensis,* Stejneger, are marked with a white stripe commencing on the side of the snout, widening under the eye and across ear, more or less bordered with black to back of shoulder, where white line generally ceases. Above this stripe is one which commences above the eye and is interrupted by two dark loops bordered with white arising from lateral line on each side and running to the median line.

The first is divided into three phases—a drab one with the lateral lines and loops, a striped one, dark brown, black, and white. This form has a wide white median stripe arising between eyes and extending onto tail. A black line between this and an upper white lateral line, then a dark brown stripe, then the lateral white line arising on side of snout, then a light brown stripe, and then white of belly. The third is a spotted form wherein the neck loops are continued along the body as two rows of rings between median and lateral lines. In greener surroundings the color is perfectly described by Stejneger except for the bright greenish yellow phase which is sometimes seen.

My most interesting observation is that the outer edge of the iris is bright steel blue. It is interesting that one species of this group and one of the *cristatellus* group (*gundlachi*) should have blue eyes.

The blue is visible on a freshly killed specimen only by making the eye bulge by pressure from the opposite side. My only addition to the color description of *A. krugi* is that they are frequently seen solid sooty black above, like *cristatellus*. The dorsal black dots are specific, in *A. krugi* immediately separating this from the other two slender species. Also the heavier head is immediately recognized.

In *A. pulchellus* I add that the center of the fan is purplish in Puerto Rico, the rest crimson.

My series contains 62 specimens of *A. poncensis*, 45 of *krugi*, and 162 *pulchellus*. The range of *A. poncensis* was considerably increased when on September 6, 1931, 21 specimens were taken along the road between Aguierra and Jabos. On April 3, 1932, in company with Dr. N. L. Britton, both species were found in the same field two miles west of Coamo Springs—*A. poncensis* occupying the fence posts and *A. pulchellus* the brush. The male *A. poncensis* had the scales of the vestiginal fan, a bright straw yellow.

A ready means of separating alcoholics is: *A. krugi*, numerous black dots above and usually below prominent white lateral line; *A. pulchellus*, usually a few vertical yellow marks, outlined in dark, above and frequently some below lateral white line; *A. poncensis*, oblique marks on nape, lateral white line short. This failing, coarse dorsals.

NEW OR INTERESTING TROPICAL AMERICAN DOTHIDEALES—III. (*, **)

CARLOS E. CHARDON

Our knowledge of the group of parasitic fungi of the order Dothideales has been rapidly increasing in the past few years. This is specially true with regards to the tropical American forms, which have been extensively collected and studied by Sydow, Stevens, Seaver, Ciferri and Petrak. Since the writer's second contribution on that order in 1929 (1), the following papers have appeared dealing on that group:

Dr. H. Sydow, the outstanding authority on the order has published a paper (12), in collaboration with Dr. F. Petrak, on the fungi of Costa Rica, based on collections made by professor Alberto M. Brenes. A year later, Sydow published in his "Fungi Venezuelani" (11) the results of his expedition to Venezuela. Petrak and Ciferri, in their "Fungi dominicani" (3), based on collections made by the latter mycologist and by Dr. E. L. Ekman, have also increased our knowledge of this group from Santo Domingo.

Professor F. L. Stevens, of the University of Illinois, an active collector and student of the order has recently published three papers (8, 9, 10), based on his own collections from Costa Rica, British Guiana, Panama, Ecuador and Peru. Finally, the writer, in collaboration with Señor R. A. Toro, published the "Mycological Explorations of Colombia" (2) describing a number of new species from Colombia and Panama.

The number of new species described in these six contributions, plus those described in the present paper, give a sum total of fifty-four, which is relatively large, considering that the Dothideales was up to recent times believed to be a small and unimportant order of fungi. The total number of *Phyllachora* from tropical America reported by Theissen und Sydow in their classical work on the group (13) in 1915 was 322. Since that time, considerable attention has been given to their collecting and study, and the number of known species has been greatly increased.

There seems to be still a wide field for investigation and oppor-

(*) Contribution from the Biology Department, University of Porto Rico, No. 2.

(**) For first paper see Mycología 19: 295–301. 1927. For second, see Jour. Dept. of Agric., Porto Rico, 13: 3–15. 1929.

tunities in this group for the collector and taxonomist. Cuba, the entire territory of Mexico, Guatemala, Haiti, Jamaica, the Lesser Antilles, the greater portion of the Andean region, the immense Amazon basin, Bolivia and Peru, may still be considered as *terra incognita*, as far as our knowledge of this order is concerned, with only a few scattered collections being reported here and there. The only tropical countries in America whose species are well known are Porto Rico and Costa Rica, and even in these two small countries, as evidenced by the present paper, new species are still to be found. Santo Domingo, certain portions of Colombia, Panama and the coast of Venezuela have also been fairly well studied, but still need considerable exploration.

It is hoped that this contribution may help to keep alive the interest in this important order of plant parasites and stimulate further taxonomical research and exploration. A great deal has yet to be accomplished before we have a comprehensive knowledge of the species of the group.

The writer wishes to express his appreciation to various mycologists and correspondents who have facilitated the progress of this investigation by communicating specimens and portions of type material from the various world herbaria. Among these are: Dr. H. Sydow, of Berlin, who has supplied a number of his types from Costa Rica and Venezuela; Dr. Augusto Scala, director of the Museo de la Plata, Argentine, who has generously mailed for examination the complete set of types of Phyllachora described by the late Dr. Carlos Spegazzini; Dr. John A. Stevenson, in charge of the mycological collections at the Bureau of Plant Industry, Washington, D. C., for sending specimens collected by the late Dr. W. A. Kellermann, by Dr. Paul C. Standley and Mr. H. Schmidt, in Central America; Dr. F. L. Stevens, of the University of Illinois, for supplying portions of type material of his collections from various tropical countries; Dr. Fred J. Seaver, curator of the New York Botanical Garden, for remitting his collections from Trinidad and other undetermined material from the Garden herbarium, and Dr. R. Ciferri, of Moca, Santo Domingo, for sending an interesting collection made by him and by Dr. E. L. Ekman in that neighboring island. Professor H. H. Whetzel has been keenly interested in the progress of our work and made available all the material needed from the herbarium at Cornell University. His cooperation in this work has been a great stimulus and source of inspiration which deserve due acknowledgment. To the various other mycologists who have contributed more limited amounts of material and to the phanerogamists who

have identified the hosts, especially to Dr. N. L. Britton, the writer wishes to express his appreciation.

My laboratory assistants, Miss Josefa Velázquez and Miss Luz M. Vilariño, deserve credit for their help in sectioning the material, making some observations and records of specimens. Thanks are due also to the Rev. Padre Rivera, of Humacao, and to Mr. Rafael A. Toro for the preparation of the latin diagnoses.

The system of classification of the order into families, tribes and genera, given by Theissen und Sydow in "Die Dothideales" (**13**) is followed here, as the best treatment available. The tribal differences in the Phyllachoraceae, especially between the Trabutiineae and Scirrhiineae, based on the subcuticular and subepidermal position of the stromata, though not entirely satisfactory and difficult to follow in practice, is still accepted here.

Family Phyllachoraceae

tribe 1. trabutiineae.

Trabutia Basanacanthae Chardon sp. nov.

Stromata hypophylla subcuticularia, papillata nigra; loculi epidermales; asci paraphysati, clavati cylindracei; sporae distichae v. inordinatae, hyalinae ellipticae.

Stromata hypophyllous, small, about 1 mm. or less in diam., raised above the leaf surface, black, shiny, becoming confluent and forming much larger, concentrically arranged conspicuous stromata, 3–7 mm. in diam. with the surface papillate with numerous protruding necks; the position of the stroma being distinctly subcuticular; locules at first few 1–3, seated on the epidermal layer, with the roof-like clypeus above, flat conical in shape, 200–240 × 125–140 u, later becoming very numerous in the larger, confluent stromata; asci clavate to cylindrical-clavate, 8-spored, 45–54 × 12–14 u, with the spores partially biseriate to inordinate; spores hyaline, 1-celled, long elliptical, 9–12 × 5–6 u; paraphyses present. (Plate XIV, fig. 4)

This is a distinct species, apparently undescribed heretofore and characterized by the large, concentrically arranged stromata resembling those of *Catacaumella Gouaniae* Stevens. The position of the stroma is distinctly subcuticular, being located between the cuticle and the large, conspicuous row of epidermal cells.

On *Basanacantha* sp.

Brasil: Parecy, Bureau Plant Ind. *66619* (coll. J. Rick) 1924 (*type*, communicated by J. A. Stevenson).

Trabutia brasiliensis (Speg.) comb. nov.

Phyllachora brasiliensis Speg., Fungi Arg. **4**: 142.

The type specimen deposited at the Museo de la Plata has been

examined. It consists of only two small leaves and the asci and spores were readily examined and measured; the asci are clavate to subclavate, 67–78 × 22–29 u, with the spores broad ellipsoidal arranged biseriately or inordinate, 14–20 × 9–12 u. Cross sections of the leaves showed the position of the stroma distinctly subcuticular and the species should be removed to *Trabutia*. (Plate XIV, fig. 1)

On Rutaceae, probably *Xanthoxylon*.

BRASIL: Apiahy, Puiggari *1486*, April 1881 (*type*).

TRIBE 2. SCIRRHIINEAE.

Catacauma Serjaniae (Speg.) comb. nov.

Phyllachora Serjaniae Speg. Anal. Mus. Nac. Buenos Aires **23**: 92. 1912.

Characterized by the large, conspicuous, concentric stromata in the epiphyll. The position of the stroma is subepidermal and hence the fungus is a *Catacauma* under Theissen und Sydow's treatment.

On *Serjania caracasana*.

ARGENTINE: Calilegua, Salta, (Museo La Plata Speg. herb *188*) Nov. 1911 (*type*).

Catacauma Amyridis (Seaver) comb. nov.

Phyllachora Amyridis Seaver, Mycologia **20**: 215. 1928.

A microscopical examination of the type material, from Desecheo Island, shows that the stroma is subepidermal and the species falls under *Catacauma* in Teissen & Sydow's keys. It is a beautiful and conspicuous species.

On *Amyris elemifera* L.

PUERTO RICO: Desecheo Island, Britton, Cowell & Hess. *1633*, Feb. 18–19, 1914 (*type*, communicated by F. J. Seaver).

SANTO DOMINGO: Boca del Infierno, Prov. Samaná, Ciferri *4560* (coll. Eckman), June 24, 1930.

According to Seaver (loc. cit.) the species is also known to occur in Cuba, Bahamas, Florida.

Catacauma venezuelensis (Sydow) comb. nov.

Phyllachora venezuelensis Sydow, Ann. Mycol. **28**: 107. 1930.

An examination of the type (no. *830*) shows the epidermal position of the stroma, which makes the fungus fall under *Catacauma*. This is a very conspicuous and beautiful species: The stromata are epiphyllous, black, circular, 2–5 mm. across, with the surface distinctly papillate from the protruding locular necks; spores biseriate or inordinate, rarely uniseriate, ovate to elliptical, 10–18 × 9–14 u. In

the Costa Rican material, the fungus occurs on the pods also. (Plate XV, fig. 1)

On *Machaerium robiniaefolium* (D. C.) Vogel.

VENEZUELA: Puerto La Cruz, Sydow f. exot. exs. *830*, Jan. 6, 1928 (*type*).

On *Mach. Humboldtianum* Vogel.

VENEZUELA: La Victoria, Aragua, Sydow f. exot. exs. *831*, Jan. 27, 1928.

On *Mach. Moritzianum* Benth.

VENEZUELA: Cotiza, near Caracas, Sydow *60*, Dec. 19, 1927.

On *Mach. biovulatum* Micheli.

COSTA RICA: Near San José, Schmidt *CR 47, 52, 54* & *61* (Bureau Plant Ind.) 1928–29 (communicated by J. A. Stevenson).

On *Machaerium* sp.

TRINIDAD: North out to Belle View, Seaver *3142*, Mar. 12, 1921; Gasparee Island, Seaver *3437*, April 27, 1921.

Catacauma Puiggarii (Speg.) comb. nov.

Phyllachora Puiggarii Speg., F. Puigg. no. 319.

A beautiful species with small, shiny stromata. A microscopic examination of the type specimen shows that the stroma is distinctly supepidermal, and hence the fungus is a *Catacauma*. (Plate XIV, fig. 7)

On Leguminosae ("folia parvula imparipinnata").

BRASIL: Apiahy, Sao Paulo, Puiggari *2770* (Museo La Plata Speg. herb. *231*) 1888 (*type*).

Catacauma rimulosa (Speg.) comb. nov.

Phyllachora rimulosa Speg., Bol. Acad. Nac. Ci. Cordoba **23**: 568. 1919.

A distinct conspicuous species apparently common in the vicinity of San José, Costa Rica. The clypeus is sub-epidermal and hence would fall under *Catacauma* in Theissen and Sydow. The stromata are epiphyllous, large, irregular but definite, conspicuous, black shiny, 3–6 mm. across, papillate in the surface due to the minute protruding ostiola; spores uniseriate, elliptical, 14 × 8 u, sometimes bigutulate. In the same stromata are found locules producing linear, fusiform conidia, 5–8 × 1 u, hyaline, 1-celled, born on large filiform sterigmata, 20–25 × 1 u.

In the original Spegazzini specimen, the host is reported as a Myrtaceae. In the publication of the original diagnosis, it is given as "*Eugenia* (costaricensis?)". In the several specimens collected

by R. Schmidt, the host has been determined as *Myrcia Oerstediana* Berg.

On *Myrcia Oerstediana Berg.* (det. P. C. Standley).

COSTA RICA: Near San José, coll. A. Tonduz (Museo La Plata Speg. herb. *177* Dec. 1897, (*type*); near San José, Schmidt *CR 6, 13, 20, 88* & *91* (Bureau Plant Ind.) 1928–29 (communicated by J. A. Stevenson).

Catacauma tropicalis (Speg.) comb. nov.

Phyllachora tropicalis Speg.—F. Argent. III, n. 67.

The stromata in the type specimen, which have been carefully sectioned, show that the clypeus is subepidermal and hence the species belong to *Catacauma*. This character was unknown to Theissen und Sydow (**13**) who never saw the type "original nicht geschen", so they included it as a *Phyllachora*.

On *Psidium Thea.*

ARGENTINE: Cordoba (Museo La Plata Speg. herb. *204*) no date ? (*type*).

PHAEDOTHIOPSIS EUPATORII Stevens, Bot. Gaz. **69**: 252. 1920.

Stevens says with regards to the morphology of this species: "The clypeus is strictly epidermal, and under it very numerous loculi develop, each with an ostiole reaching through the clypeus. The occasional pressing of the perithecia into the mesophyll sometimes gives this the appearance of closer relationship to the Phyllachoriineae, but its relationship is clearly with the Scirrhiineae". This is the first record of the species outside of Porto Rico.

On *Eupatorium portoricense* Urb.

PUERTO RICO: Dos Bocas, below Utuado, Stevens *6866*, Dec. 30, 1913 (*type*).

On *Eupatorium* sp.

HONDURAS: Vicinity of Siguatepeque, Bureau Plant Ind. *56448* (coll. P. C. Standley) Feb. 14–27, 1928 (communicated by J. A. Stevenson).

TRIBE 3. PHYLLACHORIINEAE.

Phyllachora vaginata Chardon sp. nov.

Stromata elliptica v. linearia, sparsa, atra; loculi numerosi globosi; asci paraphysati, cylindracei; sporae octonae, hyalinae, oblique monostichae v. distichae, ellipticae.

Stromata long-elliptical to linear, 1–1.5 mm. × .5 mm., scattered, seldom coalescing; black, conspicuous in the epiphyll, appearing in the hypophyll at first as discolored, slightly raised leaf tissue, with the black stroma appearing later, not surrounded by a conspicuous

zone of dead tissue; locules several (2–4) in each stromata, approximately globose, flask shaped or angular on adjacent sides; asci cylindrical 8-spored, 65–80 × 9–12, with the spores obliquely uniseriate or partially biseriate; spores 1-celled, hyaline, elliptical, 9–12 × 5–6 u; paraphyses present.

The spores of this species agree in shape and measurements with those of *Phyllachora guianensis* Stevens, but it is different in stromatal characters, lacking the characteristic zone of dead host tissue and in other minor characters. Hence the species is apparently new and described as such. The three host grasses are very closely related species.

On *Paspalum vaginatum* Sw.

Santo Domingo: El Jovero, Seibo, Ciferri *4577* (coll. Ekman), July 24, 1930 (*type*).

On *Paspalum distichum* L.

Santo Domingo: Same locality, Ciferri *4604,* (coll. Ekman) July 24, 1930.

On *Paspalum Saugetti* Chase.

Santo Domingo: Cuesta de Piedras, Cordillera septentrional, Prov. Puerto Plata, Ciferri *4803,* Dec. 9, 1930.

Phyllachora cornispora-necrotica Chardon, Bol. Real Soc. Esp. Hist. Nat. **28**: 116. 1928.

Phyllachora Paspali Earle in herb.

Most specimens are characterized by the possession of a dead zone of host tissue around the stromata (see plate 1, fig. 1, loc. cit.) but this character is not found in all the specimens. The shape of the spores, however, is distinctive; they have an attenuated appendage in the lower end, similar to the spores of *Phyllachora cornispora* Atkinson.

The species is known to occur in Colombia, Panama and Porto Rico. This is the first report from Guatemala.

On *Paspalum virgatum* L.

Guatemala: Los Amates, Dept. Izabal, Bureau Plant Ind. *60868* (coll. W. A. Kellermann), Feb. 15, 1908 (communicated by J. A. Stevenson).

Phyllachora Molinae Chardon, Jour. Dept. Agric. Porto Rico **14**: 252. 1930.

This was found to be a common species in the Andean region of Colombia, producing long yellowish spots, and linear rows of stromata 2–5 mm. long (like *Ph. Chaetochloae* Stevens). The fact that

it is also found in Santo Domingo indicates a possible wider geographical distribution.

On *Paspalum paniculatum* L.

SANTO DOMINGO: Estación Agronómica, Haina, Ciferri *4574*, Dec. 12, 1925.

Phyllachora Standleyi Chardon sp. nov.

Stromata amphigena, ad epiphyllum prominulo pustulata in circulum disposita, loculi 1–3 in quoque stromate, saepe circulares; asci paraphysati, cylindracei v. leniter clavulati, sporae monostichae, ovoideae, hyaline, continuae.

Stromata amphigenous, conspicuous, black, not shiny, more visible and pustular in the upper surface of the leaf, roughly circular, not exceeding 1 mm. in diameter, 1–3 loculate, with the locules facing the upper surface and the stroma much more conspicuous above than below, sometimes the black stroma scarcely reaching the hypophyll; locules roughly circular, or angular resulting from lateral pressure, 160–300 × 150–200 u; asci cylindrical-clavate, 8-spored, 80–95 × 10–11 u, with the spores uniseriate; spores 1-celled, hyaline, ovoid, 10–12 × 5–6 u; paraphyses present.

This species has spores resembling those of *Phyllachora Leptochloae* Chardon, but they are ovoid instead of elliptical. The stromatic characters are also peculiar to the species: the hypophyll is very often devoid of the stromatic tissue, but it is found abundantly in the epiphyll. The species is dedicated to its collector Dr. Paul C. Standley, the well known tropical explorer and phanerogamist.

On *Panicum sphaerocarpon* Ell.

HONDURAS: Vicinity of Siguatepeque, Bureau Plant Ind. *56023* (coll. P. C. Standley) Feb. 14, 1923 (*type*, communicated by J. A. Stevenson).

PHYLLACHORA ANTHEPHORAE Sydow, Ann. Mycol. **13**: 439. 1915.

The type of this species is from Jamaica (Mayor *350*) and it has been made available by the courtesy of its collector. It is also known to occur in Costa Rica on the authority of Stevens (**7**). It had not been recorded from Porto Rico, but the following two collections, examined at the New York Botanical Garden agree with the type. It is to be noted that the species has not been found by recent collectors in the island.

On *Anthephora hermaphrodita* (L.) C. Kuntze.

PORTO RICO: "Manati ad Coto *6735* Sintenis Collector" (at N. Y. Bot. Garden); "Santurce Mr. & Mrs. A. A. Heller collectors" (idem).

Phyllachora minima Chardon sp. nov.

Stromata amphigena, punctiformis, sparsa v. saepius laxe gregaria, minuta, nigra 1–2 loculates; loculi ad mesophyllum; asci cylindracei, octonae; sporae monostichae, continuae, hyalinae; paraphysis filiformibus paucis.

Stromata very small, punctiform, scattered or seldom coalescing, black, amphigenous, less than .5 mm. across, 1-loculate or seldom 2-loculate thru coalescence; locule in the mesophyll, stroma brownish black, true Phyllachora-like, surrounded on all sides by stroma, subglobose but slightly angular in the corners, 80–110 × 75–100 u; asci cylindrical, 8-spored, 60–72 × 7–8 u, with the spores uniseriate; spores hyaline, 1-celled, broad elliptical with obtuse end, smooth, 7–9 × 4–5 u, paraphyses filiform, scarce.

The stromata in this species are very small, resembling those of *Phyllachora microspora* Chardon and *Ph. Panici* (Rehm.) Theiss & Sydow. In the former species, the spores are long-elliptical, 5–6 × 4–4.5 u, similar in shape to our specimen, tho a trifle smaller. *Ph. Panici* occurs on *Panicum* and is known only from the type locality from Rio Janeiro. *Ph. Bouteloуae* Rehm. and *Ph. bouteloуicola* Speg. occurring on *Bouteloua* in Argentine, have larger spores. Apparently the species is new to science.

Bouteloua heterostega (Trin.) Griff.

PUERTO RICO: Near Reform School, Mayagüez, Chardon *3291*, Dec. 6, 1931 (*type*).

PHYLLACHORA CLORIDICOLA Speg., Anal. Mus. Nac. Buenos Aires III, 12:416. 1909.

The type species is reported on *Chloris radiata* from La Rioja, Argentine. It has not been made available to the writer, but the other known Argentine specimen has been examined and agrees well with the published diagnosis. The Venezuelan material has asci and spores of the same shape and measurements, but the position of the stroma is different, since it is always amphigenous, and not restricted to the epiphyll. The occurrence of this species in Venezuela, suggests a wider geographical range.

On *Chloris radiata* (L.) Sw.

ARGENTINE: La Rioja (coll. Speg. ?) Dec. 1904 (*type* not seen).

VENEZUELA: near Ocumare, Toro *59*, Dec. 1930.

On *Chloris* sp.

ARGENTINE: Juarez Celman, Cordoba (Museo La Plata Speg. herb. *252*) Jan. 5, 1930.

Phyllachora Leersiae Chardon sp. nov.

Stromata amphigena, nigra minute punctiformis, sparsa, linearibus disposita, loculi solitari, utrimque planissima lenticulares ad mesophyllum immersi; asci paraphysati, cylindracei-clavati, octoni; sporae inordinatae v. monostichae, hyalinae, continuae, elliptico-subfusoideae, utrimque subacutiusculae.

Stromata amphigenous, black, small, punctiform, about .5 mm. across, scattered or in groups with a linear arrangement, inconspicuous: locule single, 200–250 × 120–135 u, flat lenticular or oblong, located in the mesophyll, with black stroma on all sides; asci cylindrical-clavate, 8-spored, 54–60 × 12–14 u, with the spores biseriate or inordinate; spores hyaline, 1-celled, long elliptical to navicular, with ends subacute, 16–19 × 6–7 u; paraphyses present.

This is apparently a new species on a genus of Gramineae not previously known to have been parasitized by a *Phyllachora*. The navicular spores, inordinately arranged in the subclavate asci are characteristic.

On *Leersia* sp., aff. *monandra* Sw.

SANTO DOMINGO: Road to San José de las Matas, Prov. Santiago, Ciferri *4557*, July 12, 1931 (*type*).

Phyllachora Leptochloae Chardon sp. nov.

Stromata amphigena, nigra pallescens, 2–3 loculatae ad mesophyllum immersae: loculi globosi; asci paraphysati, cylindracei-clavati; sporae saepius oblique monostichae, ellipticae, continuae, hyalinae; stylosporis granularibus, viridis.

Stromata amphigenous, conspicuous, black, not shiny, equally visible on both sides of the leaf, roughly circular but tending to be elongate and parallel to the long axis of the leaf, 2–3 loculate with the stroma in the mesophyll: locules nearly globose, 200–250 × 150–200 u; asci cylindrical clavate, 8-spored, 85–100 × 10 u, with the spores obliquely uniseriate; spores 1-celled, hyaline, smooth, navicular, 12–15 × 5–7 u, stylospores present, 12–16 × 3 u, granular and with light greenish contents, paraphyses present.

The stromata are characteristic of the graminicolous *Phyllachorae*, black, conspicuous, not shiny, visible on both sides of the leaf; the locules (2 to 3) are approximately globose or completely immersed in the mesophyll and surrounded on all sides by the black stromatic tissue. No species is reported by Theissen und Sydow (**13**) nor in subsequent works on tropical America, on *Leptochloa*.

On *Leptochloa virgata* (L.) Beauv.

HONDURAS: La Fragua, Bureau Plant Ind. *55759* (coll. P. C. Standley) Feb. 7, 1928 (*type*, communicated by J. A. Stevenson).

PHYLLACHORA CHAETOCHLOAE Stevens, Ill. Biol. Monog. **83**: 19. 1923.

Ciferri's specimen from Santo Domingo agrees very well with the type from Trinidad (Stevens *882*) in ascospore shape and dimensions, as well as in the possession of two distinct types of conidia. Seaver's collection from Trinidad appears to be the same.

On *Chaetochloa setosa* (Sw.) Scrib.

SANTO DOMINGO: Santiago, flats near Yaque river, Ciferri & Ekman *no number*, Dec. 1930.

On *Chaetochloa* sp.

TRINIDAD: Heights of Aripo, Seaver *3237*, Mar. 16, 1921.

PHYLLACHORA ANTIOQUENSIS Chardon, Bol. Real Soc. Esp. Hist. Nat. **28**: 118. 1928.

This is one of the most characteristic graminicolous *Phyllachorae* with its conspicuous black stromata covering a large part of the host tissue. The host is a tall grass, seldom showing inflorescence and quite common in waste places in the "tierra templada" of Colombia. These are the first reports outside of Colombia.

On *Imperata contracta* (H. B. K.) Hitch.

SANTO DOMINGO: Sabana de la Mar, Cordillera Central, Prov. Samaná, Ciferri *4555* (coll. Ekman, July 13, 1930).

On *Imperata brasiliensis*.

SANTO DOMINGO: Pimentel savanna, San Fco. de Macoris, Ciferri *4550*, Feb. 1930.

On *Imperata* sp.

TRINIDAD: Piarco Savanna, Seaver *3205*, Mar. 13, 1921.

Phyllachora Sorghastri Chardon sp. nov.

Maculae indeterminatae; stromata amphigena, nigra, linearia; loculi 1–2 lenticulares v. elliptici; asci paraphysati, cylindracei clavati; sporae inordinatae, continuae, hyalinae, ellipticae, obtusiusculae, guttulatae.

Stromata amphigenous, black, linear, 1–3 mm. long × .5–1.0 mm. across, producing slight discolored spots indefinite in outline, locules 1–2, lenticular or elliptical, 160–225 × 100–140 u, surrounded on all sides by black stromata; asci cylindrical-clavate, 8-spored, 90–110 × 16–18 u, with the spores inordinate; spores hyaline, 1-celled, long elliptical, with one end obtuse, 14–16 × 6–8 u, provided with many small oil droplets; paraphyses present.

An apparently new species, on a host not previously known to have been parasitized by a *Phyllachora*. The subclavate asci and inordinate spores are typical.

On *Sorghastrum parviflorum* H. & Ch.

SANTO DOMINGO: Sabana de la Mar, Samaná, Ciferri *4579* (coll. Ekman), July 9, 1930 (*type*).

Phyllachora tetraspora Chardon sp. nov.

Stromata conspicua ad epiphyllum, nigra pallescens, linearia, opaca ad hypophyllum, fusca maculla cincta; loculi 1–2 globosi, extus grosse clypei, intus contextu atro-fuscae; asci paraphysati, clavati, tetraspori, guttulati; sporae inordinatae, hyalinae, continuae, ellipticae, 1-guttulatae.

Stromata conspicuous in the epiphyll, black, not shiny, linear, 2.5 mm. long × .5–1.0 mm. broad, faintly visible in the hypophyll, in the form of brown, ashy spots, wrinckled in its surface; locules 1–2, globose flattened to angular, 150–250 × 120–165 u, with thick clypei on the top, and black-brownish stromatic tissue on the sides and bottom; asci clavate, 54–65 × 12–14 u, 4 spored, provided with numerous, globose, oil droplets, with the spores inordinate; spores hyaline, 1-celled, long-elliptical, 16–19 × 5–7 provided with a small oil droplet; paraphyses present. (Plate XIV, fig. 2)

A species forming conspicuous, black, linear stromata. It is different from other species occurring on the tribe Bambusae, in possessing 4-spored asci. Only known from the type collection.

On *Bambos vulgaris* Schrad.

SANTO DOMINGO: Hato del Yaque, Prov. Santiago, Ciferri *4554*, July 10, 1931 (*type*).

Phyllachora Guaduae Chardon sp. nov.

Stromata amphigena, atra, nitidula, linearia disposita; loculi 1–2 lenticulares, ad mesophyllum immersi; asci paraphysati, cylindraceiclavati, octoni; sporae distichae, continuae, hyalinae, fusoideae utrimque acutae.

Stromata amphigenous, very conspicuous, equally visible on both surfaces of the leaf, black, shiny, 3–4 mm. long × 1 mm. wide, arranged loosely in long linear rows, parallel to the main axis of the leaf, causing yellow longitudinal streaks in the leaves; locules 1–2 in cross section, lenticular or angular on the adjacent sides, 160–200 × 120–150 u, completely immersed in the mesophyll of the leaf, surrounded on all sides by the thick stroma; asci cylindrical, clavate, 8-spored, with the spores biseriate in the main body of the ascus, 70–95 × 12–15 u; spores 1-celled, hyaline, smooth, long fusoid with pointed ends, 16–18 × 6–7 u; paraphyses filiform, inconspicuous.

Differs from *Phyllachora gracilis* Speg., reported on a Bambusaceae from Peribebuy, Brasil, in having slightly smaller spores, and very conspicuous linear stromata over twice as long. The species was erroneously determined by Chardon (**2**) as *Phyllachora bonariensis* Speg., based on Gaillard's no. *257* from Venezuela, which is deposited at the N. Y. Botanical Garden and appeared determined as such but both are species. It seems to be a common fungus on the well known "guadua".

On *Guadua latifolia* Kunth.

COLOMBIA: Quebrada Sinifana, Antioquia, Chardon *93,* May 25, 1926; Hacienda El Hatico, between Cerrito and Palmira, Chardon & Nolla *346,* May 23, 1929 (*type*); along Quindio river, near Armenia, Chardon *710,* July 14, 1929.

VENEZUELA: Atures "Haut Orenoque", Gaillard *257,* Aug. 1887 (at N. Y. Bot. Garden).

Phyllachora Kyllingae Chardon sp. nov.

Stromata amphigena, in limbo utrimque perspicua, atra, nitidula, ad epiphyllum innata superficialia, ad hypophyllum atra pallescens; loculi bilineares, 5–8; asci paraphysati, cylindracei-clavati, octoni: sporae continuae, hyalinae, fusoideae, acutae, distichae.

Stromata amphigenous, 1–2 mm. long × .5 mm. wide, equally visible from both leaf surfaces, black, shiny and pustular in the epiphyll, dull black and smooth in the hypophyll; fructification compound, made up of 5 to 8 locules all immersed in intense black stroma and arranged in two rows, the upper one with 3–5 angular locules, 150–175 × 65–80 u (a few 250 × 150 u) and a lower row of 2–3 locules smaller in size; asci cylindrical-clavate, 70–85 × 6–7 u, 8-spored; spores 1-celled, hyaline, long navicular, 15–17 × 4–5 u, biseriate in the ascus; paraphyses present. (Plate XIV, fig. 6)

The stromata are characteristic of the graminicolous *Phyllachorae,* slightly raised and shining black in the epiphyll; the stroma is characterized microscopically by possessing two rows of locules. There being apparently no species reported on *Kyllinga,* and the stromatic and spore characters being so distinct and peculiar, it is hereby described as a new species.

On *Kyllinga brevifolia* Rottb.

COSTA RICA: Near San José, H. Schmidt *CR 28* (Bureau Plant Ind.) 1928–29 (*type,* communicated by J. A. Stevenson).

PHYLLACHORA GALACTIAE Earle; Seaver *in* Britton, Bahama Flora: 633. 1920.

Phyllachora Lathyri (Lev.) Theiss. & Sydow *in* Seaver and Chardon, Sci. Surv. Porto Rico **8**[1]: 52. 1926.

Phyllachora gelatinosa Sydow, Ann. Mycol. **28**: 104. 1930.

Phyllachora Bradburyae Stevens (?) in herb.

The type species is from New Providence, Bahamas on *Galactia rudolphoides.* Stevens and Dalbey (**6**) referred numerous forms collected in Porto Rico on *Galactia striata* and *Bradburya virginiana,* to *Phyllachora Lathyri* (Lev.) Theiss. & Sydow. Chardon (Mycol. **12**: 319) referred two collections of Whetzel and Olive on *Galactia* to *Ph. Galactiae* Earle, after confirmation by the late F. S. Earle. On the basis of this divergence of opinion, Seaver and Chardon (**5**)

referred the species on *Bradburya* to *Ph. Lathyri*, following Stevens, and the species on *Galactia* to *Ph. Galactiae*, following Chardon and Earle.

This reference to two different species appears to be a mistake, since *Ph. Lathyri* is a temperate species occurring on *Lathyrus* in Europe, Asiatic Russia and Central Asia, while the Porto Rican species is strictly tropical. A microscopic reexamination of all the Porto Rican material, both on *Galactia* and *Bradburya* has convinced the writer that they belong to one species, namely *Ph. Galactiae* Earle. The same species was reported by Toro (**14**) from Santo Domingo on *G. striata* and by Chardon and Toro (**2**) from various stations from Colombia on the same host.

Sydow (**11**) has recently described *Ph. gelatinosa* sp. nov. on *Bradburya pubescens* from Venezuela, and the material is very suggestive of *Ph. Galactive* and it is here reduced to synonymy. A specimen recently collected by Toro in Venezuela on *Bradburya* is certainly *Ph. Galactiae*, with spores navicular, biseriate, 18–20 × 5–6 u. A specimen at the N. Y. Botanical Garden, collected by Stevens from Ecuador on *Bradburya* is also identical.

This settles in our judgment the confusion which existed, and *Ph. Lathyrii* is excluded from the flora of tropical America, while *Ph. Galactiae* is now understood in a clearer light and its range greatly extended.

On *Galactia striata* (Jacq.) Urban.

PUERTO RICO: Johnston, *4945;* Stevens, *5644;* Fink, *1661* & *2091;* Whetzel & Olive, *574* & *575;* Chardon, *920, 1528* & *1529;* Whetzel, Kern & Toro, *2582.*

SANTO DOMINGO: Kern & Toro, *213* & *277.*

COLOMBIA: Chardon, *416, 431, 575* & *683.*

On *Galactia dubia* DC.

PUERTO RICO: Woods near sea, Earle *27*, Summer 1903.

On *Bradburya virginiana* (L.) Kuntze.

PUERTO RICO: Stevens, *1887, 4314, 5036* & *5991;* Whetzel & Olive. *651.*

ECUADOR: near Teresita, col. F. L. Stevens no *188*, Oct. 31, 1924 (det. as *Ph. gelatinosa* sp. nov.)

VENEZUELA: near Ocumare, coll. R. A. Toro no. *117*, Dec. 25, 1930.

On *Bradburya Plumieri.*

ECUADOR: near Teresita, Stevens *108*, Oct. 29, 1924 (specimen at N. Y. Botanical Garden labelled *Phyllachora Bradburyae* sp. nov.)

On *Bradburya pubescens.*

VENEZUELA: Puerto La Cruz, Sydow f. exot. exs. *825*, Jan. 1, 1928 (type of *Ph. gelatinosa* sp. nov.)

Phyllachora Chamaefistulae Chardon sp. nov.

Stromata epiphylla, atra, nitidula, errumpentia, sparsa, globosa, matrici immersa 1–2 loculata; loculo globosi ad epiphyllum dehiscenti; asci cylindracei-clavati; sporae distichae, hyalinae, fusoideae, grosse guttulate.

Stromata epiphyllous, black, shiny, slightly raised, scattered, round, about 0.5 to 0.8 or seldom 1 mm. in diameter, rarely hypophyllous, with the stroma clearly occupying the mesophyll of the leaf, with 1–2 locules; locules approximately circular or sometimes slightly irregular, opening in the epiphyll, 190–240 × 140–170 u; asci 8-spored, cylindrical-clavate, 95–110 × 12–14 u with the spores biseriate in the ascus; spores hyaline, 1-celled, long navicular, large, 26–30 × 5–6 with a conspicuous, large oil drop in each spore; paraphyses present.

This is apparently an undescribed species and the first one known on the genus *Chamaesfistula*, although others are known to occur on its closely related genus *Cassia*. The large, navicular, uniguttulate spores are characteristic.

On *Chamaefistula antillana* Britton & Rosé.

PUERTO RICO: Mountains above Yauco, Whetzel, Chardon & Toro, *3239*, May 24, 1931 (*type*).

Phyllachora Noblei Chardon sp. nov.

Maculae fuscae, amphigenae, determinatae; stromata globosa pallescens atra; loculi globosi; asci paraphysati, cylindracei clavati; sporae distichae v. inordinatae, hyalinae, fusoideae.

Spots slightly exceeding the stromata in the form of a brownish dead zone, encircling them and about .5 mm. across; stromata approximately circular, black, amphigenous, not shiny, flat, about .5 in diameter, 1–2 loculate; locules globose or slightly flattened on adjacent wide 180–215 × 160–100 u; asci cylindrical-clavate; 8-spored, 65–84 × 10–12 u, with the spores biseriate or inordinate; spores hyaline, 1-celled, navicular, or long lemon-shaped, smooth, 14–16 × 8–10 u; paraphyses present. (Plate XIV, fig. 3)

A rare species known from two collections from the limestone hills along the road to Cataño. It is probably extensive with the tertiary limestones of the north coast of Porto Rico, where the host is abundant. Dedicated to Mr. David Noble, enthusiastic geological explorer who accompanied the writer in the expedition in which the type specimen was found.

On *Chiococca alba* (L.) Hitch.

PUERTO RICO: Limestone Hills along Cataño road in Iriarte Farm, Whetzel, Kern & Toro *2796*, June 28, 1924; Hills along the Bayamón–Toad road, Chardon *3512*, Jan. 13, 1932 (*type*).

Phyllachora perplexans Chardon nom. nov.

Catacauma Ocoteae Stevens Bot. Gaz. **69**: 251. 1920.

The nomenclature of this species is somewhat perplexing. Stevens described it as a *Catacauma* but evidently he did not make median sections thru the stromata. Careful sectioning has been shown that there are clypei above and below, typically *Phyllachora*-like. The species is thus removed to Phyllachora but the specific name *Ocoteae* is untenable in that genus, since there is *Ph. Ocoteae* P. Henn. from Brasil. Hence a new specific name, *perplexans*, is proposed here.

On *Ocotea leucoxylon* (Sw.) Mez.

PUERTO RICO: Monte Alegrillo, near Maricao, Stevens *732*, Mar. 4, 1913 (*type*).

PHYLLACHORA OCOTEICOLA Stevens & Dalbey Bot. Gaz. **68**: 57. 1919.

Ph. Ocoteicola Speg. in herb.

Ph. Ocoteicola var. *costaricensis* Stevens, Illinois Biol. Monog. **11**: 37. 1927.

Examining Spegazzini's types, furnished by the Museo de la Plata, a specimen was found on *Ocotea diospyrifolia* from Calilegua, Argentine, which is labelled "*Phyllachora ocoteicola* Speg. n. sp." This name was not published, and the same specimen was referred by Spegazzini to *Ph. Ocoteae* P. Henn. (See Myc. Argent. no. *1450*). The Porto Rican material and the type of *Ph. ocoteicola* Stevens & Dalbey have been examined: the original description has spores "17 × 54 u", which is a gross typographical mistake, and it has been corrected to the actual measurements found, 16–20 × 5–7 u. Stevens new variety *costaricensis*, has been examined: it was based on minor stromatal characters, which were also found in other specimens and the validity of the variety is questioned.

On *Ocotea leucoxylon* (Sw.) Mez.

PUERTO RICO: Monte Alegrillo, Stevens *4768*, Nov. 14, 1913 (*type*); Monte de Oro, Stevens *5969*, Dec. 3, 1913; Finca María, Yauco, Whetzel, Kern & Toro, *2510*, June 18, 1924.

On *Ocotea* sp.

COSTA RICA: Peralta, Stevens *390*, July 12, 1923.

Phyllachora catsbyana Chardon sp. nov.

Stromata amphigena, parva, atra, nitidula, ad epiphyllum errumpentia, loculi singuli, subglobosi; asci paraphysati, cylindracei, octoni; sporae monostichae, hyalinae, continuae, ellipticae.

Stromata amphigenous, small, angular, about 1 mm. across, black shining and raised in the epiphyll, dull black and smooth below; locule single, subglobose, 200–240 × 175–210, with heavy clypeus above, and dull black stromatal tissue on the sides and below; asci cylindrical, 8-spored, 75–85 × 10–11 u, with the spores uniseriate; spores hyaline, 1-celled, long ellipsoidal, 8–11 × 5–6 u, paraphyses present. (Plate XVI, fig. 2)

Apparently a distinct species, with much smaller spores than other *Phyllachorae* known on *Ocotea*. The small, uniloculate stromata are also characteristic.

On *Ocotea catsbyana*.

FLORIDA: Key Large, coll. M. F. Barrus, deposited at Cornell University herb. *19113,* Mar. 20, 1931 (*type*).

Phyllachora Ciferri Chardon sp. nov.

Maculae amphigena, indeterminata 5–10 mm.; stromata amphigena, parvis, punctiformis, nigris nitidulis; loculis singulis, globosis v. lenticularibus, ad mesophyllum immersis; asci clavatis v. saccatis, octonis; pedicello breviusculo; sporis inordinatis, hyalinis, granularibus, paraphysis filiformibus.

Spots amphigenous, appearing as discolored, indeterminate areas, 5–100 mm. across; stromata amphigenous, small, punctiform, round, .8 to 1 mm. in diameter, black, shiny, prominent, seldom coalescing but occurring in groups of 3–25 in each spot; locule single in each stroma, globose to lenticular, 210–300 × 150–200 u; immersed in the mesophyll with distinct thick black clypei above and below and heavy stroma on the sides; asci clavate or saccate, 8 spored, 60–85 × 16–21 u, with the pedicill short and the spores biseriate or inordinate; spores hyaline, 1-celled, elliptical, 14–16 × 6–9 u, with a distinct wall and granular contents; paraphyses filiform, very scarce or none. (Plate XV, fig. 2)

This species differs from all other known on *Phoebe* in its conspicuous groups of punctiform stromata and also in its spore measurements. The species is dedicated to the well known mycological explorer Dr. Ciferri.

On *Phoebe montana* (Sw.) Griseb.

SANTO DOMINGO: Sanchez, Peninsula de Samana, Ciferri *4173* (coll. Eckman), April 19, 1930 (*type*).

On *Phoebe* sp.

COSTA RICA: San José, Schmidt *CR 2, 71* and *87* (Bureau Plant. Ind.) 1928–29.

Phyllachora consociata Chardon sp. nov.

Praecedentis etiam affinis sporarum ascorumque fabrica praecipue tamen recedens. Asci non cylindraceis v. vix paraphysatis, sporis ellipticis.

Same macroscopic and stromatal characters as *Ph. Ciferri;* asci 8-spores, cylindrical or cylindrical-clavate, 72–85 × 6–9, with the spores obliquely uniseriate, or partially biseriate; spores hyaline, 1-celled, long elliptical, 9–11.5 × 4.5–5 u; paraphyses inconspicuous.

This peculiar species appeared associated on the same spots as the above; the stromatal characters were the same, but asci and spores different, both in shape and size.

On *Phoebe montana* (Sw.) Griseb.

SANTO DOMINGO: Same *type* specimen as above.

PHYLLACHORA SERJANICOLA Chardon, Mycologia **13**: 293. 1921.

Phyllachora sapindacearum Stevens, Ill. Biol. Mong. **11**: 39. 1927.

This species was previously known to occur from Porto Rico (the type is Chardon no. *923* from Peñuelas) where it is abundant, and also from a single collection by Kern & Toro (no. *143*) from Macoris, Santo Domingo. All of them are on *Serjania polyphylla* (L.) Radlk.

The Venezuelan material has stromata 2–3 loculate, with locules 175–250 u across, asci clavate, 8-spored, with spores mostly uniseriate, but sometimes partially biseriate; spores ellipsoidal, 10–12 × 6–7 u. Compared with the type specimen it appears to be the same.

The type species of *Ph. sapindacearum* Stevens from Panama has been examined and it appears to be the same as the Porto Rican and Venezuelan material above mentioned. The spores are also ellipsoidal mostly uniseriate in the asecus, 10–12 × 6–7 u. It is therefore considered as a synonym. No doubt, the species has a wider distribution in tropical America. It should not be confused with *Ph. insueta* Sydow, on *Serjania,* reported from Costa Rica and Colombia, which is very different in stromatal and spore characters.

On *Serjania polyphylla* Radlk.

PORTO RICO: Peñuelas, Chardon *923,* July 27, 1920 (*type*); Mayagüez, Stevens *1196,* May 4, 1913; Bayamón, Johnston *1151,* Jan. 1, 1914; Peñuelas, Chardon *896,* Aug. 11, 1920; id. Chardon *1530,* July 1921; Coamo Springs, Britton *3457,* Jan. 5, 1922; Playa Sardinera, Fajardo, Chardon *1554,* Apr. 11, 1922; Cayey, Chardon *1555,* Apr. 15, 1922; Vieques Island, Whetzel, Kern & Toro *2641,* July 17, 1924; Ciales Road, W. K. & T. *2639.*

SANTO DOMINGO: Macoris, Kern & Toro *153,* Mar. 10, 1926.

On *Serjania paniculata.*

VENEZUELA: Monte Bello, near Caracas, Toro *58,* Dec. 11, 1930.

On *Serjania mexicana.*

PANAMA: France Field, Canal Zone, Stevens *1327,* Aug. 24, 1923.

Phyllachora Torrubiae Chardon sp. nov.

Maculae amphigena indeterminatae parum manifestae pallescentes; stromata 20–50, gregaria in circulum disposita, atra nitidula: loculi singulares v. 2–3, globosi, asci paraphysati cylindracei v. cylindraceiclavati, longiuscule tenuiterque pedicellati, sporis inordinatis v. distichis, hyalinis, continuis.

Spots large, irregular, in outline, sometimes spreading over a considerable part of the leaf surface, 1–3 or more cms. across, at first yellow green, then becoming much paler, visible on both sides of the leaf; stromata in groups of 20–50 in each spot, concentrically arranged in the center of the spot, individual stromata amphigenous, roughly circular to irregular thru coalescence, 1–1.5 mm. across or more, black, shiny; locule single or sometimes 2–3, globose or flattened, 220–270 × 180–250 u, lined with thread-like hyphae which fade into a brown, pseudostromatic tissue; clypeus prominent, both above 20–30 u or more thick, extending far beyond the locules; asci cylindrical to cylindrical-clavate, 8 spored, long pedicellate, 90–145 × 12–15 u, with the spores disorderly uniseriate or partially biseriate; spores 1-celled, hyaline, broad navicular or lemon shaped, 14–18 × 6–8 u; paraphyses present. (Plate XV, fig. 4)

The species is typical in the concentric arrangement of the stromata within the spots.

On *Torrubia fragrans* (Dum.) Standl.

Puerto Rico: Ravine near Quebradillas, Barrus & Chardon *3057*, Dec. 3, 1927; Limestone hills at Peñón, near Ponce, Chardon & Toro *3369*, May 7, 1931 (*type*).

Phyllachora huigraense Chardon sp. nov.

Stromata amphigena, parva, atra; loculi singuli, lenticulares v. ellipsoidei; asci paraphysati, clavati, 60–85 × 13–18 u; sporis inordinatis v. distichis.

Stromata amphigenous, small, about .5–1.0 mm. in diameter, black, approximately circular; locule single, lenticular or ellipsoidal, 300–350 × 175–200 u, surrounded on all sides by black stromatic tissue; asci clavate, 8-spored, 60–65 × 13–18 u, with the spores biseriate or inordinate; spores hyaline, 1-celled, subglobose to broad-elliptical, 9–12 × 6–8 u, with contents finely granular; paraphyses present.

There are two species of *Phyllachora* reported on *Buettneria* in the northern Andean region of South America: *Ph. vallecaucana* Chardon, from Colombia, which has larger, multilocular stromata, with elliptical, uniseriate, spores, 8–10 × 4–5 u (see fig. 12, Jour. Dept. Agric. P. R. **14** *p.* 265); and *Ph. Buettneriae* Stevens from Ecuador, with larger, multiloculate stromata, spores oblong, 10–15 × 10 u. From both of these our species seems to differ: in the small, uniloculate stromata, and in the shape and size of asci and spores.

On *Buettneria parviflora*.

ECUADOR: Vicinity of Huigra, J. N. and G. Rose, Explorations of South America *23305,* Aug. 22, 1918 (*type*).

Phyllachora verrucosa Chardon sp. nov.

Stromata in centro elevato infuscata; loculi 2–5 amphigena; globosi, asci paraphysati, cylindracei, octoni; sporis monostichis, hyalinis, continuis, ellipticeis.

Stromata very conspicuous, amphigenous, pustule-like, forming elevated pustules, raised about .5 mm. above the leaf surface, approximately circular, or irregular, 1–2 mm. across, made up of a black, shiny stroma bordered by any equally elevated host tissue; locules 2–5 in each stroma, facing the epiphyll, nearly globose, 250–320 u across, surrounded on all sides by the dense, black, stromatic tissue, on the hypophyll the stroma is usually fertile, much less elevated above the leaf tissue than in the hypohyll but also black and conspicuous; asci cylindrical, 8-spored, 85–100 × 12–15 u, with the spores uniseriate or partially biseriate; spores hyaline, 1-celled, broad elliptical, 10–13 × 7–9 u, smooth; paraphyses present. (Plate XV, fig. 3)

This is a very characteristic species possessing conspicuous black, pustulate stromata. *Phyllachora Whetzelii* Chardon has spores with the same shape and length, but it does not possess the pustule-like stromata. It is quite possible that *verrucosa* is a form of the species *Whetzelii*, the pustule-like stroma being only a host reaction. A specimen from Porto Rico (Fink no *1598*) seems to be the same but no spores were seen.

On *Eugenia buxifolia* (Sw.) Willd.

HAITI: near Cape Haitien, G. V. Nash *956*, Sept. 4, 1903 (*type*).

On *Eugenia* sp.

PUERTO RICO: Dry hill top south of Yauco, Fink *1598*, Dec. 31, 1915.

PHYLLACHORA EUGENIAE Chardon, Mycologia **19**: 300. 1927.

This is a conspicuous and beautiful species occurring on the dry limestone hills of the south coast of Porto Rico, where the host is quite common. It was known by a single specimen collected by F. L. Stevens, but it has recently been recollected by professor H. H. Whetzel and the writer. In Ekman's specimen from Santo Domingo, the stromata differ from Porto Rico material in that they are scarcely visible in the epiphyll, appearing as tan, circular spots; but in the hypohyll, the black, conspicuous spots are characteristic. Spores uniseriate or biseriate ellipsoidal, small, 8–10 × 4–4.5 u. (Plate XVI, fig. 3)

On *Eugenia rhombea* (Berg.) Krug & Urb.

PORTO RICO: Guanica, Stevens *321*, Feb. 3, 1913 (*type*) Limestone hills near Ponce, Whetzel & Chardon *3291*, May 23, 1931.

SANTO DOMINGO: Las Lagunas, Prov. Santiago, Ciferri *4250,* (coll. E. L. Ekman) Nov. 21, 1930.

PHYLLACHORA WINTERI Sacc. & Syd., Syll. Fung. **14**: 673.

Ph. Xanthoxyli Wint. not (Lev.) Cke, Hedwigia **26**: 34. 1887.

Physalospora tijucensis Rehm, Hedwigia **40**: 111. 1901.

Trabutia Xanthoxyli Chardon, Sci. Survey Porto Rico **8**: 55. 1926.

This is a difficult species to understand on account of its confusing nomenclature. *Phyllachora Xanthoxyli* (Lev.) Cooke from Java, the type of which is deposited in the Paris Museum, according to Theissen und Sydow (p. 515) looks the same, but has larger spores, 21–23 × 5–5.5 u. Winter's specific name *Xanthoxyli* is untenable and was changed to *Winteri;* most of the tropical American collections have been referred to this specific name. An examination of the type of *Ph. brasiliensis* Speg. shows asci and spores very much like *Winteri* in shape and measurements but the stromata are scattered and individual, not tending to coalesce.

A cross section thru a typical *Ph. Winteri* generally shows a subcuticular stroma, like a *Trabutia,* but occasionally a few stromata are found extending to the hypophyll and thus the fungus is retained in *Phyllachora.* The species *Trabutia Xanthoxyli* Chardon should be included as a synonym. The species is widely distributed in tropical America.

On *Xanthoxylon* sp.

BRASIL: Sta. Catharina, Rabh. F. europ. *3558* (*type* of *Ph. Winteri*); Tijuca, Rio de Janeiro, Ule *2258* (*type* of *Ph. tijucensis*); Sao Leopoldo, Rick *379,* 1908 (comm. by A. J. Stevenson).

VENEZUELA: Near Ocumare, Toro *115,* Dec. 1930 (occurring with *Ph. applanata*).

COSTA RICA: Near San José, Schmidt *CR 66* & *77* (Bu. Plant Ind.) 1928–29.

On *Xanthoxylon martinicensis* (Lam.) D. C.

PUERTO RICO: Whetzel & Olive *649,* Apr. 19, 1916 (type of *Trabutia Xanthoxyli*).

SANTO DOMINGO: Sánchez, Prov. Samaná, Ciferri *4548* (coll. Ekman), Apr. 19, 1930.

ENDODOTHELLA PICRAMNIAE (Sydow) Theiss & Syd., Ann. Mycol. **13**: 590. 1915.

Dothidella Picramniae Sydow, Ann. Mycol. **11**: 266. 1913.

Phyllachora Picramniae Stevens, Ill. Biol. Monog. **11**: 38. 1927.

The type species has been examined and the 2-celled spores clearly observed in a few asci. Most of the spores, however, are unicellular,

a fact which has brought about confusion among investigators. Stevens' type of *Phyllachora Picramniae,* was examined: the spores are non-septate and it seems to be an immature form of the above. They measure 20–26 × 5–6 u. The species has beautiful, conspicuous, circular stromata. It seems to be common in Costa Rica.

On *Picramnia bonplandiana* Tul.

COSTA RICA: Rio Virilla, Sydow f. exot. exs. *134* (coll. A. Tonduz) Oct. 11, 1912 (*type* of *Dothidella Picramniae* Sydow); Aserri, Stevens *119,* June 26, 1923 (*type* of *Ph. Picramniae* Stev.); near San José, Schmidt *32, 38, 72* & *78* (Bu. Plant Ind.) 1928–29; Vicinity of San Sebastián, south of San José, Bureau of Plant Ind. *49352* (coll. P. C. Standley) Feb. 23, 1926.

Genus SHAERODOTHIS Shear Mycologia **1**: 162. 1909.

Like PHYLLACHORA; spores one-celled, brown; paraphyses brown.

According to Shear (loc. cit.) *Sphaerodothis* was the name proposed by Saccardo and Sydow (**4**) for a subgenus of *Auerswaldia* to include the single species *A. Arengae* Rac. Shear raised it to generic rank to take care of species like Phyllachora having brown spores. Theissen und Sydow (**13**) recognized the genus and include seven species under it; three of which are from Tropical America.

The brown color of the spores, which distinguishes this genus from *Phyllachora* is a variable factor which is difficult to depend upon as a sharp basis for generic differentiation. In *Sph. portoricensis* and *Sph. luquillensis* the change of color of the spores is shown in full process of evolution. In both species, the spores in the young stage are large, hyaline to bluish, and full of granular contents and oil drops; in maturity they shrink to a smaller size (see spore measurements in the diagnosis of both species) and change to an olive brown color.

Occasionally, spores of true *Phyllachora* exhibit a few spores which are faintly brownish. Such is the case reported by Stevens (**7**) in *Phyllachora Scleriae* and *Ph. sphaerosperma,* which he changes as new combinations to *Sphaerodothis.* The writer has examined carefully many specimens of these from various countries and he has not been able to find a single spore which is distinctly brown. Admitting that a few of them are occasionally brownish, their rarity is such as to have escaped the attention of other mycologists, and both species should probably belong better in *Phyllachora* where they have always been.

Sphaerodothis trinitensis Chardon sp. nov.

Stromata epiphylla, linearia, atra; loculi singulis, lenticularibus, clypei superne; asci paraphysati, clavati, sporis inordinatis, fuscis, continuis.

Stromata epiphyllous, linear, black, 1–2 mm. long × .6–1.0 mm. wide; locule single, lenticular, 200–260 × 60–100 u, with a thick, black clypeus above, and little or no stromatic tissue on the sides or below; asci saccate or clavate, 8-spored, 46–56 × 14–16, with the spores inordinate; spores distinctly brown, 1-celled, long elliptical to navicular, 14–18 × 5–7 u, paraphyses present.

The species is distinctly a *Sphaerodothis* apparently undescribed heretofore.

On *Schizachyrium condensatum.*

TRINIDAD: Seaver *3113,* 1921 (*type*).

Sphaerodothis portoricensis Chardon spec. nov.

Stromata amphigenae, determinatae, atra pallescentes, loculi 1–2, asci paraphysatis, cylindraceis v. clavatis; sporis distichis ellipsoideis.

Stromata amphigenous, conspicuous, equally visible on both surfaces of the leaf, black, not shiny, markedly convex, 2 mm. long × 1 mm. wide, single, surrounded by a distinct zone of yellow tissue, 1 mm. wide on the sides and about 2 mm. long on each end of the stromata, seldom arranged in linear rows and coalescing to form stromata, 3–5 mm. long, and then causing yellow longitudinal streaks; locules 1–2 in cross section, globose or slightly angular on the adjacent sides, 180–250 × 100–135 u, immersed within the stroma and in the mesophyll; asci cylindrical clavate, 8-spored, with the spores biseriate in the main body of the ascus, 90–100 × 16–21 u; spores 1-celled, large at first, long ellipsoidal, 22–26 × 10–12 u, with distinctly granular contents, at maturity reducing in size, navicular, 18–21 × 7–8 u, with uniform olive brown contents; paraphyses present.

This species is close to *Phyllachora Guaduae* Chardon, reported by the writer from Colombia on *Guadua latifolia* Kunth, but falls under *Sphaerodothis* on account of the olive-brown contents of the spores. It is also close to *Sphaerodothis antioquensis* Chardon, on *Arthrostylidium* from Antioquia, Colombia, but differs from it in having a compound fructification, navicular (not elliptical, blunt) spores and contents light olive-brown. The reduction in the size of the spores occur as they approach maturity, and the change which has also been observed for *Sphaerodothis luquillensis* Chardon (1) collected by the writer, on the slopes of the Luquillo Mountains. Stevens no. *4388* collected in Utuado, P. R., on the same host, is also to be referred to this species.

On *Arthrostylidium sarmentosum* Pilger.

PUERTO RICO: Trail from forest cabin to El Yunque, Luquillo Mountains, Chardon *3368*, Mar. 29–30, 1930 (*type*); Utuado, Stevens *4388*, Nov. 8, 1913.

Dictyochorina Chardon gen. nov. (Phyllachoracearum).

Stromata biophila innata, asci paraphysati octospori; sporae triseptatae, muriformiae, hyalinae.

Stromata between the epidermis and the mesophyll; asci cylindrical to cylindrical-clavate, 8-spored; spores 3-septate, with the two central cells sometimes provided with cross-partitions, making the spore muriform, hyaline; paraphyses present. Type species: *Dictyochorina Arundinellae* sp. nov.

This genus is erected to take care of the species like *Dictyochorella*, having muriform, hyaline spores. In this latter genus, the spores are muriform, brown. No genus is known to receive the species with hyaline spores and the necessity for its erection is necessary to take care of the two species described below.

Dictyochorina Arundinellae Chardon sp. nov.

Stromata amphigena, parva, atra, convexula linearia; loculi sat numerosi irregulares, asci paraphysati, cylindracei clavati, octoni; sporis inordinatis, triseptatis, muriformibus.

Stromata small, black, slightly raised in the epiphyll, much less visible and flat in the undersurface, linear, about .5 to .8 mm. long and much less so in width, arranged in linear groups of 15–40 stromata, about 1.0–1.5 cm. long and 2–3 mm. wide, which makes them conspicuous, each small stromata unilocular, but by frequent coalescence appearing multilocular; locules flat globose, or angular thru pressure, with heavy black clypeus bordering its top and much less so on the sides 160–260 × 100–180 u; asci cylindrical-clavate, 8-spored, 68–85 × 10–14 u, with the spores inordinate; spores long ellipsoidal, 17–21 × 6–8 u; muriform, hyaline, with 3 septae and the two central cells subdivided transversely by cross partitions; paraphyses present. (Plate XVI, fig. 1)

On *Arundinella martinicensis* Griseb.

PUERTO RICO: Hacienda Miramontes, Cidra, Chardon *1716*, Feb. 15, 1931 (*type*) Mayagüez, Whetzel & Olive *553*, Mar. 7, 1916.

GUATEMALA: Los Amates, Dept. Izabal, Bureau Plant Ind. *60867* (coll. W. A. Kellermann), Mar. 15, 1905.

The specimen from Guatemala is labelled "on *Imperata contracta*" but this seems to be an error in the host determination. The asci and spores agree with the Porto Rico type, and the host appears to be the same.

Dictyochorina portoricensis Chardon sp. nov.

Stromata amphigena, atra, nitidula, colliculosa; loculli 2–5; asci

apice obtuse rotundati subcrassiuscule tunicati, basi breviter pedicellati, octospori; sporis muriformibus, 4–6 septatis, paraphysis filiformibus.

Stromata amphigenous, approximately circular, about 1.0–1.5 mm. in diameter, black, shiny, not prominent, but with both surfaces slightly rugose with the small ostiola, scattered, not confluent, surrounded by a thin zone of raised, dead host tissue, not over .5 mm. across; locules 2–3 (seldom 5) globose or approximately so, 180–300 × 165–240, immersed in the mesophyll, with heavy black clypei above and below, and stromatic tissue on the sides; asci clavate, 8 spored. 70–81 × 22–27, with short pedicell, ascus wall greatly thickened at the round apex (10–14 u across), muriform, hyaline, tapering on one end, with 4–6 septate and 1–3 cross walls; paraphyses filiform, inconspicuous. (Plate XVI, fig. 4)

This species is evidently Phyllachoraceous in stromatal characters, but the muriform hyaline spores makes it fall under our new genus *Dictyochorina*. It is known only from the type locality.

On *Eugenia axillaris* (Sw.) Willd.

Puerto Rico: Hacienda Pulgillas, Coamo, Chardon *902*, Aug. 26, 1920 (*type*).

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Explanation of Plates

PLATE XIV

(All photographs reduced to two thirds natural size)

Fig. 1. *Trabutia brasiliensis* (Speg.) Chardon, a portion of Spegazzini's type. Puiggari No. *1488* from Apiahy, Brasil.

Fig. 2. *Phyllachora tetraspora* Chardon, a portion of type, Ciferri No. *4554*, from Hato del Yaque, Santo Domingo.

Fig. 3. *Phyllachora Noblei* Chardon, leaves from Chardon *3512*, Bayamón–Toa road, Porto Rico.

Fig. 4. *Trabutia Basanacanthae* Chardon, type coll. by Rick, Bureau Plant Ind. *66619*, Parecy, Brasil.

Fig. 6. *Catacauma Puiggarii* (Speg.) (Chardon, portion of Spegazzini's type. Puiggari *2770* from Apiahy, Brasil.

Fig. 7. *Phyllachora Kyllingae* Chardon, Schmidt *CR 28*, San José, Costa Rica (type).

PLATE XV

Fig. 1. *Catacauma venezuelensis* (Sydow) Chardon, portion of type, Sydow *830*, Puerto La Cruz, Venezuela.

Fig. 2. *Phyllachora Ciferri* Chardon, portion of type, Ciferri *4173*, coll. Ekman, Sanchez, Santo Domingo.

Fig. 3. *Phyllachora verrucosa* Chardon, portion of type, Nash *956*, Cap Haitien, Haiti.

Fig. 4. *Phyllachora Torrubiae* Chardon, portion of Chardon & Toro *3369*, Ponce, Porto Rico.

PLATE XVI

Fig. 1. *Dictyochorina Arundinellae* Chardon, portion of type, Chardon *1716*, Cidra, Porto Rico.

Fig. 2. *Phyllachora Catsbyanae* Chardon, portion of type, Barrus *19113* (Cornell), Key Largo, Florida.

Fig. 3. *Phyllachora Eugeniae* Chardon, portion of Ciferri No. *4250*, coll. Ekman, Las Lagunas, Santo Domingo.

Fig. 4. *Dictyochorina portoricensis* Chardon, portion of type, Chardon *902*, Coamo, Porto Rico.

PLATE XIV

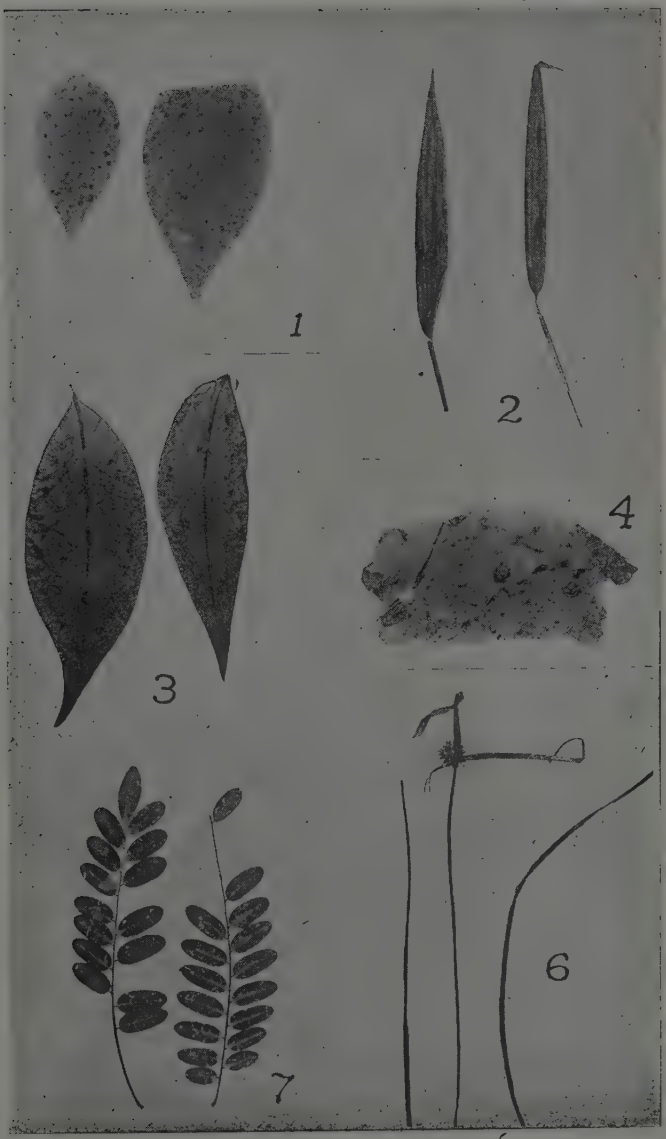


PLATE XV

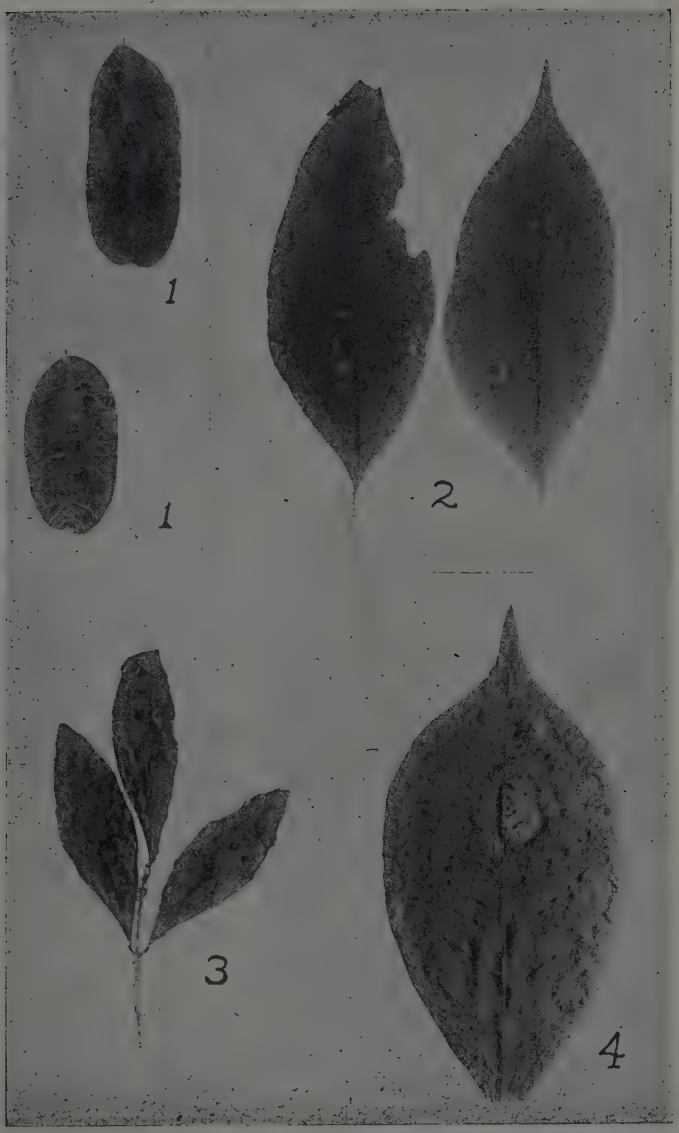
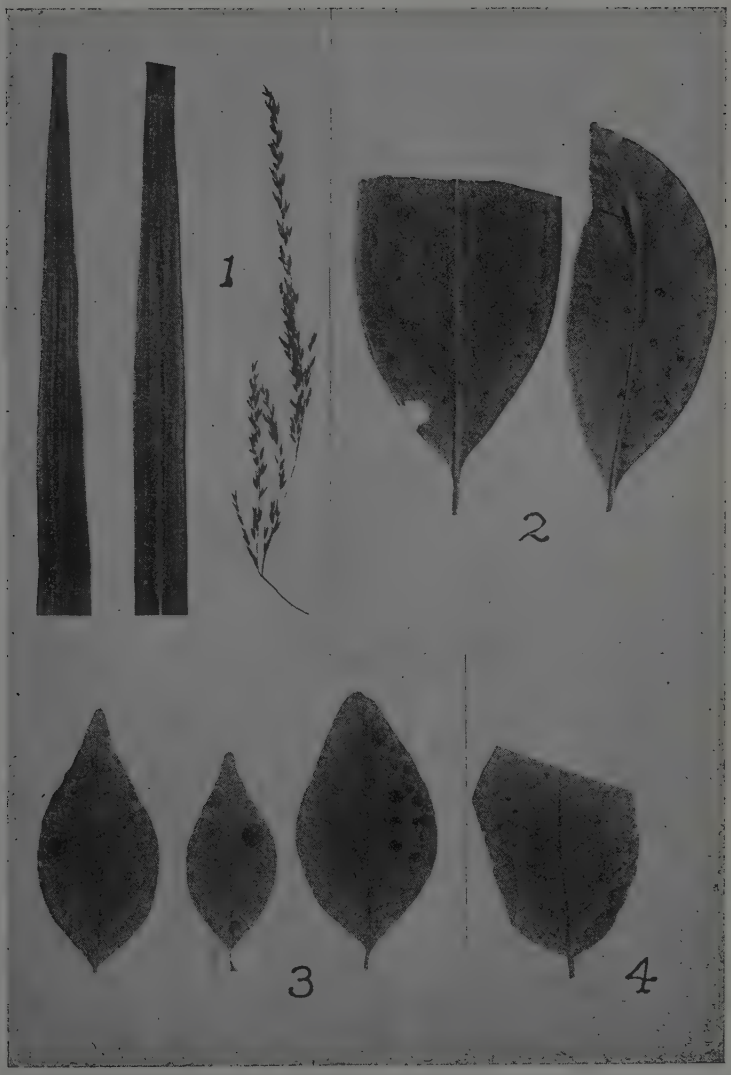


PLATE XVI



THE BROWN ROT FUNGUS IN PUERTO RICO [1]

JAIME R. GUISCAFRÉ

(With one plate and one figure in the text)

INTRODUCTION

Inasmuch as there are various causes of disease in Citrus in which a gum exudate in the trunk is a characteristic symptom; the term brown rot, as has been applied to the *Phytophthora (Pythiacystis)* type of gummosis has been selected as the most proper for the disease here reported. Mal-di-gomma or foot root rot also attacks the trunk and branches while other two forms of gummosis common in Porto Rico, grapefruit gummosis and psorosis of oranges, may exhibit similar symptoms.

The disease here reported was for the first time found on affected groves at the Eugenia plantation, near Añasco, while endeavoring to discover the possible causes of gum disease in Citrus. While mal-di-gomma is very prevalent in that region, the *Phytophthora* rot plays no minor part in the havocs caused by the gum-type symptoms of disease. A preliminary report of this work has already been published by the writer and the present paper presents the results obtained in the studies of the disease.

The writer wishes to express his appreciation to Professor Rafael A. Toro, under whose direction the work was done, for suggestion of the problem, reading and correction of the proof and for invaluable aid and encouragement.

SUSCEPTS

PLANTS AFFECTED

Brown rot appears to be an important disease of the genus *Citrus*.

VARIETAL SUSCEPTIBILITY

The sour orange, (*C. Aurantium*) is the most resistant variety. In many cases the wounded tissues of orange trees have healed rapidly and the fungous growth being checked. The common lemon (*C. Limonum*) and the West India Lime (*C. aurantifolia*) are highly susceptible. The sweet orange (*C. sinensis*) and grapefruit (*C. grandis*) are between the highly susceptible *C. aurantifolia* and the very resis-

[1] Contribution from the Department of Botany, and Plant Pathology No. 1, College of Agriculture and Mechanic Arts, University of Porto Rico. Publication authorized by the Chancellor.

tant species, *C. Aurantium*. No case has been reported of the disease occurring in the mandarin (*C. nobilis*) while, according to T. Fahmy, citron (*C. Medica*) is quite susceptible. Citron is the most common stock used in Egypt. The sweet lime (*C. Limetta*) was found to be susceptible in Palestine, where recently 20 per cent of Jaffa oranges, budded on sweet lime stock, were killed. The author also had the opportunity of observing a severe case of brown rot in the wild grapefruit tree (*C. maxima*) found in a coffee plantation at Mayagüez.

The Disease

Names

The disease is known by several names. Due to the fact that the causal fungus cause brown rot in lemons, it is generally called brown rot. It is also known as gummosis, but this is not a very appropriate term for the disease, since other several causes may contribute to this symptom.

History and Range

In the early literature on citrus diseases there are many reports from different citrus-producing districts on the occurrence of gum exudates and gum diseases, but the forms reported are not accurately described; therefore, it is difficult to identify the causal agent.

The earliest serious outbreak of gummosis, occurred in the Azores Islands in the year 1834; although Ferrari in 1646 and Sterbeek in 1682 had already reported milder cases of the disease. Fouque (1873), referring to this destructive outbreak in the Azores Islands said that "sweet-orange trees 200 to 300 years of age which were producing 6,000 to 20,000 oranges a piece, were found to be affected by a serious form of gummosis. The trees put on heavy crops of fruits and the leaves turned yellow and fell off in great quantities".

Gum disease was reported from Italy between 1862 and 1878, by Savastano, Reggio and others. It was reported from the Balearic Islands (Spain) in 1871. Very recently it was reported in the orient by Reinking (1921) and Lee (1925). In 1885 it was reported from New Zealand by Kirk and from Cape Colony, South Africa in 1891. Gummosis made its appearance in California in the year 1875 and in Florida in 1876. Garey states that gummosis was the most serious epidemy of 1878; for this reason common lemon, lime and citron stocks were no longer used, and the sour orange was unanimously adopted, due to its high resistance. Outside from the United States, it has been reported from Cuba by Cook (1906) and Cook and Horne

(1908); from Brazil by Averna-Sacca (1917); from Mexico by Gándara (1910); from Paraguay by Bertoni (1911). It was not until 1918 that the disease was reported from Porto Rico by Stevenson.

Since the disease made its appearance, investigators from different localities, have stated their opinion as to the causative agent. Briosi (1878) who studied the disease in Italy, described a fungus *Fusarium limoni,* associated with gummosis; his description being very similar to that for *Phytophthora citrophthora.* In 1891, Comes from Italy, also produced gum by inoculation with a bacterial species called *Bacterium gummosis.* Swingle and Webber (1896) considered the gum disease as infectious and caused by organisms invading the bark. Fawcett and Burger (1911) and Fawcett (1912 *c,* 1913 *a*) showed that a fungus similar to *Diplodia natalensis* produced gumming of branches.

Other investigators have concluded that gum diseases in *Citrus* are due not to organism, but to certain external stimulus against the affected region. Among these Sorauer (1872) in Germany and Prillieux (1874) in France, were the first to arrive at this conclusion, as a result of their work as to the cause of gum in the genus *Prunus,* the two genera being closely related. But Savastano, after working with both genera concluded that gummosis in *Citrus* is due largely to wounds or traumatisms. In recent years, Savastano has modified his earlier view recognizing that there is a gummosis formed as a result of the response of the tree to some external stimulus, and that there is another one caused by specific organism.

Importance

Brown rot is a serious disease of citrus fruits. During the first months, the lesions are rather few and of relatively small area; in no way impairing the vigor of the tree. As the lesions extend into the branches of the trees, the folliage begins to be partially affected. In the last stages the lesions are so great that they really girdle the tree, causing the yellowing of leaves and finally defoliation. The lesions destroy the food-conducting vessels of the tree, affecting the leaves and fruits. The fruits remain undersize, ripen very late in the season, and the rind takes a dirty brown color.

The disease was so serious in California in 1878, that Garey (1882) referred to it as the only important disease at that time. When it appeared in the lemon trees in California, the industry was greatly injured, because not only was the orchard affected, but also the fruit spoiled after being packed. In the fruit the disease is called brown rot and it is readily transmitted by contact. The causal organism

produces no spores in the fruit, but the disease is readily transmitted by pieces of mycelium of the fungus.

There is no accurate estimation of the economical importance of the disease in lemons in California, but during the first year, following its appearance, it caused great losses, both in the orchard and in the market.

Nobody has estimated the losses due to the disease in Porto Rico, but a visit to the Eugenia Grove, a few kilometers from the town of Añasco, showed that the disease is of great importance. There are areas in which many trees are seriously affected; in others, however, young trees have been planted where the old ones died, and these trees are also affected, and producing fruits undesirable for the market. The fruit of affected trees is coarse, of dirty brown coloration, sour and insipid.

Symptomatology

Morphologic symptoms

The pathogene, generally affects the base of the trunk, and then works upwards, the lesions being always greater in length than in width. The bark is killed in patches accompanied by the exudation of gum, but the injury is not superficial, but rather deep, the cambium being included always in the affected region. In other kinds of gummosis, such as *Botrytis gummosis,* the bark is softened. In brown rot gummosis, the bark remains hard until it is dry and then it cracks longitudinally. The exudation of gum, has been thought to be a physiological product of the reaction of the cells to protect the tree from rot-producing organisms. In resistant stocks, however, the lesions are self-limited, being a few inches long and wide, but on the susceptible species the author measured lesions of even 15 inches in length and 5–7 inches wide. As the disease progresses, the leaves on the side of the branches more seriously affected, begin to turn yellow, and finally die and fall. Superficially, the exudated gum is the most characteristical symptom of the disease. If the bark is removed, there is a more or less definite boundary between the sound and the infected area; this boundary being characterized by a light brown shaded area.

The bark at this time is yet firm, only the color is changed, from a pale normal green to a light brownish shade. The gum was observed to be formed near the cambium, in pockets 1 to 2 inches deep. The gum at the place of origin, is watery and clearer, while when coming through the bark, it becomes dark brownish red and denser. Later it turns dark brown, and becomes brittle due to the loss of

water. The gum is deposited in oval masses, on the bark or follows the contour of the longitudinal cracks. In the last stages of the disease, the bark shrinks and cracks, leaving a surface covered with hardened gum, thus protecting to some extent the inner tissues from the invading rotting fungi. In the fruit the fungous causes a brown discoloration which gradually involves a great area of the rind. Sometimes gum exudates from the center of the spot.

SIGNS

Only in the laboratory are the characteristic signs of the disease showed.

HISTOLOGIC SYMPTOMS

Tissue from the bark was not examined for histological symptoms. Sections from rind of infected fruits of the Mexican Lime (*C. aurantifolia*) were made and occasionally observed. The mycelium grows in thick masses in the lemon rind and is formed both intra and extracellularly. Disintegration of the cell wall was observed after few days of inoculation. A brown color was developed all around the place of inoculation.

Etiology

NAME HISTORY AND CLASSIFICATION OF THE PATHOGENE

The organism was first isolated from diseased lemon trees, in California and named *Pythiacystis citrophthora* by Smith. Wilson unable to find any reproductive bodies suggested that the fungus be classified under sterile mycelium forms, while Leonian, after a physiological study of several species of the genus *Phytophthora* found that *Pythiacystis citrophthora* Sm. and Sm., was a *Phytophthora* and transfer the species to that genus. The organism is known to-day as *Phytophthora citrophthora* (Sm. & Sm.) Leonian.

PATHOGENICITY

Fawcett found that inoculation into sound trees with bits of diseased tissue transmitted the disease with all its characteristic symptoms; but, however, only diseased tissue from the marginal fringe of the killed bark of active lesions was capable of transmitting the disease. He also made inoculations with bits of lemon fruits affected with brown rot and produced the disease. The author, after isolating the fungus from diseased trees, inoculated ripen lemons, and the characteristic brown rot was produced. Reisolation proved the fungus causing it identical to that found in the diseased trees.

LIFE HISTORY

The life history of the fungus is very simple.

When the soil is wet the mycelium is capable of producing sporangia and spores. If dry periods follow, the sporangia remained in a resting stage until favorable conditions return; however, during this time the fungus reproduces by means of pieces of its mycelium, and the disease is transmitted easily to the bark and fruits.

During wet seasons, the sporangia, which are produced in the soil, discharges biciliate motile spores which swim about, reach the bark, or fruit lying close to the ground and readily germinate, producing mycelium again. The organisms do not produce sporangia either in the bark or in the fruit. All attempts to find the sexual stage of the organism have failed. The author observed structures similar to what should be the sexual stage, but there were not convincely of their identity.

PATHOGENESIS

INOCULATION

The main sources of inoculation are the mycelium found in the soil, bark and fruits, and the spores which are only found in soil. Chlamydospores are also found on the soil and serve as inoculon.

According to Fawcett, the period of inoculation of the fungus varies. With several inoculations he produced the characteristic disease after four months, in other instances. after six months. He recorded the death of a lemon tree after eighteen months from inoculation.

SAPROGENESIS

Phytophthora citrophthora lives saprophytically in the soil debris only and here produces spores and chlamydospores.

INOCULATION

The sporangia, chlamydospores and mycelium are carried by the water to different places of the orchard and the spattering rains, tools and animals will probably transport them and infect the sound trees.

CHARACTERISTICS OF THE FUNGUS

Four different culture media were used to study the fungus. These were: corn-meal agar, corn-meal agar plus 5 per cent citric acid, moist clay soil and Cook II media. Sporangia could not be ; roduced in any of these media; even all trials with the moist clay

soil failed to produce sporangia. The organism grew more luxuriantly at room temperature from 77°F average, in the corn-meal agar plus 5 per cent citric acid. Twenty-four hours after inoculation the fungus grew about ¼ inch, concentrically; at 48 hours was 1 inch; at 72 hours, 2 inches; at four days all the petri dish was covered with mycelium. Cultures after four weeks old turned to an ashy color. The mycelium is non-septate, profusely branched and cottony. In young cultures it is pure white, but as the culture becomes old it turns gray and ashy. The author examined the solid cultures daily and no sporangia were noticed from the first day of inoculation to six-week-old cultures, which were then left aside. The material was obtained from diseased trees in the Eugenia Grove, near the town of Añasco.

Material from different parts of the tree was tried in the following way: diseased tissue from the lesions and from 6 inches and one foot away from the lesion, respectively, were used. In no instance the tissue from itself produced the fungus, but only the material gathered from 6 inches and 1 foot away produced the characteristic mycelium.

After the writer failed to obtain sporangia from wet-soil cultures, a new method was developed. This method consisted in concentrating the corn-meal agar in the center of the petri dish forming a round mass of about 2 inches in diameter and ¼ inch thick, leaving a margin between this mass and the petri dish of ¾ inch. In this place, sterile water was poured. An inoculation was made with a bit of the mycelium in the center of the mass and from then on, the culture was examined daily. After 5 weeks, when the water became slimy, sporangia were abundantly produced. Continued examination showed that 6–7 weeks the sporangia became scarce while a flush of chlamydospores and conidia were conspicuously abundant. The sporangia observed were lemon-shaped, in some cases elongated while in others more rounded with a protuberance at the tip. Intercalary sporangia were found in some occasions and sporangia with two pores were observed. They showed a wide range in size and shape, but in the average they were 8 u long and 6 u wide. The chlamydospores range from well-rounded ones to elongated and averaged 6 u in diameter. Spores were seen germinating and they were of approximately the same size as the chlamydospores. The sporangiophores were rather short: 2 u in length, but there were some which attained 16 and 18 u.

In the first attempts to isolate, the organism always an infection of a *Fusarium* species was present; according to Fawcett the secondary infection of the *Fusarium* species slightly increases the injury of

P. citrophthora. The only way of getting rid of this secondary infection was by inoculating healthy lemon fruits with the mixed culture after which *P. citrophthora* remained alone in the inoculated lemons, isolating from this the fungus in pure cultures.

Epiphytology

Gummosis caused by *P. citrophthora* needs several factors in order to develop in an orchard. The factor of prime importance is moisture, the secondary ones being: injuries, favorable temperature and the resistance or susceptibility of the stock used. The injuries of any nature are not essential for the rapid development of the disease; whenever moisture and favorable temperature prevail, the fungus enters the bark easily.

Moisture is the essential factor for spreading the disease. For example, in the Eugenia Grove, the trees are budded low, it rains abundantly, from 70 to 80 inches annually and the water table is often found at 1 to 1½ foot below the surface. This is a favorable place for the development of the disease.

Control

prevention

In all diseases, the methods for prevention are the cheapest and most easily carried out, but they are often neglected by the growers. There has been formulated some very good methods for the prevention of gummosis. These are: (1) plant the trees in mounds, in this way the tree will have its roots well exposed and, therefore, afford less chance for the development of the disease; (2) by avoiding injuries of any sort to the bark or crown roots; (3) providing a good drainage system, and, finally, (4) used, where possible, resistant stocks such as sour oranges.

Other methods are: paint the basal part with Bordeaux paste, and, in places where irrigation water is used, dig the soil among the main roots and leave a circular ridge around the tree.

Another method which has proved very successful is tree surgery. This consists in scraping the bark slightly to see the extent of the infection. Then the "invaded area", or brownish zones, is dessected out with a heavy knife cutting thru the wood about ½ to 1 inch beyond the invaded zone on the sides and from 1 to 2 inches beyond both at top and bottom. The cut above and below are made at an acute angle. Then the wound is desinfected by any of the commercial desinfectants such as Bordeaux paste, using 1 pound copper sul-

fate and 2 pounds rock lime to 1½ gallons of water. Protexol may be used also. After this treatment, the purpose of which is to kill spores or mycelium present, the wound is painted.

College of Agriculture and Mechanic Arts, University of Porto Rico, Río Piedras, P. R.

Explanation of Plates

PLATE XVII

Grapefruit trees at Hacienda Eugenia showing effects of *Phytophthora citriphora* infection.

PLATE XVIII

A.—The mycelium showing its non-septate condition and its habitual way of branching.

B.—Usual type of sporangia at several stages of development.

C.—Sporangia and chlamydospores showing their characteristic forms and shapes.

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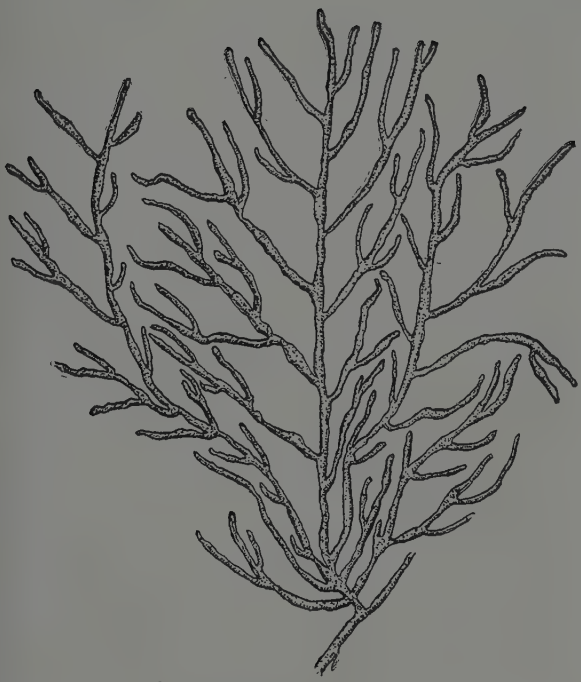
PLATE XVII

PLATE XVIII



A.

B.

THE DAMPING OFF OF TOBACCO AND ITS CONTROL IN PUERTO RICO

By J. A. B. Nolla, B.S.A., M.S.

The paper deals with a very severe disease of tobacco seedlings in Puerto Rico, two organisms, *Pythium debaryanum* and *Phytopthora Parasitica* var. *nicotinae* having been found to be causal agents.

The symptoms produced by two pathogens are very similar and are mainly of the necrotic type. Small seedlings when affected usually rot completely while larger seedlings may show other symptoms. On the latter, small, lens-shaped or elongated lesions, or large necrotic areas which often cause the girdling of the stems, are evident. Affected seedlings occasionally send out roots above the lesions in an effort to recover. If infected with *Pythium debaryanum* such seedlings may develop into normal plants when transplanted, but if the lesions are produced by *P. Parasitica,* death takes place within a short time after transplanting. In infections by *P. Parasitica,* a leaf spot is usually part of the symptomological picture.

Of the environmental factors which favor the spread and severity of the disease, probably the most important is moisture; while temperature, not being a very variable factor in Porto Rico, at least below the limits which might hinder the development of the pathogens, seems to be of less significance. When adequate moisture relations are maintained, the disease appears to be equally severe during all seasons of the year. It is maintained that the disease spreads very rapidly and with great severity in thickly sown beds.

The known methods of eradication and protection for this disease and their merits in Puerto Rico are discussed.

The spread of the disease may be checked in some instances of light infection by drenching diseased areas with a 1 to 30 formaldehyde solution, but it is clear that protection can not be afforded by this means when the spores of the fungous agents have been disseminated by surface currents or drainage water prior to the treatment.

For tobacco seed-beds a successful fungicide or soil disinfestant should be of continued action and should either eradicate the pathogens from the soil or protect the seedlings from infection up to the time of transplanting. Formaldehyde and steam disinfestation are effective methods when reinfestation is prevented. Their use in

Puerto Rico is not practicable because of the high cost of application and because in that island the system of seed-beds is such that reinfestation can not be prevented.

In experiments under controlled conditions, copper stereate, Uspulun, Bayer dust, copper sulfate, copper flousilicate and acetic acid have proven to be ineffective in controlling the disease. Trials with Corona copper carbonate (about 20 per cent metallic copper) at different rates of application show that fairly satisfactory eradication and protection is afforded with two applications of four grams of the dust, one a week before sowing the seed, the other two weeks after germination. In field trials when the dust is applied after the disease has started, the treatment is ineffective.

Experiments with Bordeaux mixture (4–4–50 and 5–5–50) have proven the effectiveness of this fungicide as a soil disinfestant for damping-off in tobacco. Two applications should be made, one a week before sowing the seed, and another two weeks after germination, the rate of application being one-half gallon of the mixture for every square foot of bed surface.

When copper fungicides are applied to the soil on beds soon after a crop of seedlings has been grown, injury to seedlings of the second crop results. Such injury does not occur when the chemicals are applied to a soil which has not previously grown tobacco. The injury results in imperfect germination, and in yellowing, stunting and a defective root system of the seedlings. Such a condition is attributable to indirect action of the copper compounds which may either react with substances excreted into the soil by the seedlings of the preceding crop, or may affect the soil flora in a deleterious way. A hindrance of the activities and development of the beneficial soil microorganisms may cause starvation of the seedlings.

THIELAVIOPSIS PARADOXA; AN IMPORTANT DISEASE OF SUGAR CANE

By Melville T. Cook, *Plant Pathologist,*
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The rotting of seed cuttings of sugar cane, caused by this fungus led to the studies which are recorded in this paper. A review of the literature shows that poor germination of seed cuttings of sugar cane have been studied in other parts of the world and have been attributed to many causes, such as *Colletotrichum falcatum* in Louisiana and India, to *Marasmius plicatus* in Louisiana, to *Marasmius sacchari* in Puerto Rico, to *Ceratostomaella adiposum* in India, to *Lasiodiplodia theobromae* in Philippine Islands and *Thielaiopsis paradoxa* in many places.

The first record of this fungus was not from the tropics but from France where it was described by De Seyenes in 1886 under the name of *Sporoschisma paradoxum.* In 1892 Saccardo gave it the name of *Chalara paradoxa* (De Seyenes) Sacc.

In 1893 it was reported from Java by Went under the name of *Thielaviopsis ethacetica,* by which it is known in much of the literature. He also gave it the common name of pineapple fungus because it produced an odor in the decaying cane similar to ripe pineapples. This is the first record of the fungus in the tropics and the first record of its attacking cane that has come to the attention of the writer. In 1904 von Höhnel recognized the fungus described by Went was the same as the one described by De Seyenes and made the new combination *Thielaviopsis paradoxa* (De Seyenes) Von Höhnel. In 1928 Dade reported the results of studies on a fungus on the Gold Coast of Africa and the finding of what he believed to be the perfect stage. As a result of these studies he made the new combination of *Ceratostomaella paradoxa* (De Seyenes) Dade. In consideration of the fact that the predominant stage of the fungus is *Thielaviopsis paradoxa,* the writer will use that name.

The fungus has a very wide geographical distribution and attacks a large number of plants, including areca palm, oil palm, date palm, coconut palm, pineapple and banana.

In 1893 Massee published a paper "On *Trichosphaeria sacchari,* Mass., A fungus Causing a Disease of Sugar Cane", as a result of studies on material received from the British West Indies. The text

of this paper indicates that the author confused two or more species in his description and some of his drawings are evidently of *T. paradoxa*. A part of his description of the behavior of the fungus corresponds very well to that of *T. paradoxa*. He says,—

"Although a true parasite, in the sense of destroying perfectly healthy, living tissue, the fungus almost invariably commences as a saprophyte, the conidia germinating on the remains of dead leaf-bases scars formed by broken lateral branches, roots &c., the hyphae afterwards passing into the living, uninjured tissue of the cane; and judging from the fact that the disease is always most mature at the lower and older portions of the cane, it is evident that the fungus effects an entry by the means indicated. The cultures described also prove that the fungus can pass through the entire cycle of its development as a saprophyte."

Three years later Went of Java published a paper entitled "Notes on Sugar Cane Diseases" in which he criticized the work of Massee. He says,—

"In most cases this disease only attacks cuttings, though it may be found in the stems of half-grown or full-grown cane too, if these are damaged; but this last mode of occurrence of the disease is rare."

* * * * * * *

"The paper by Massee on *Trichosphaeria sacchari* gave me the impression that what he calls the macro- and micro-conidia of this fungus are similar to or very little different from the form which I have described as *Thielaviopsis athaceticus*. This opinion was confirmed by the material I received from the West Indies containing so-called macro- and micro-conidia of *Trichosphaeria*, which could not be distinguished from my *Thielaviopsis*."

* * * * * * *

"*Thielaviopsis ethaceticus* is a general saprophyte, behaving sometimes as a wound parasite, and then causing the pineapple disease of the sugar cane in Java."

Butler (1906) of India wrote as follows,—

"One of the most serious cane diseases of Java is that caused by this fungus. It Attacks chiefly planted-out sets, which are rotted by its action and consequently fail to germinate. Cut or bruised canes that are exposed to its attacks are readily infected, and hence the danger to which canes reserved for seed are exposed, while they are stored or in transit, is considerable. Through the unbroken rind of the culm infection appears rarely to occur."

Johnson and Stevenson (1917) of Puerto Rico say that,—

"The injury caused by this fungus is restricted to the cane cuttings. An affected cutting is usually killed either before any shoots are produced or before the new shoots can establish themselves on their own roots. The loss due to this disease varies considerably, depending upon the variety of cane, moisture conditions in the soil, and possibly other factors. . . Not all seed which fail to germinate have been invaded by this fungus, but it is responsible for the death of a large proportion. Out of one lot of dead seed examined, twenty-five per

cent showed this disease and another lot but ten per cent. The loss in some instances, however, must be much higher. Of healthy seed growing under normal conditions a negligible per cent will be attacked. The disease makes great headway whenever conditions for prompt germination are lacking, and become especially severe if the seed has been left in piles or sacks for some time after cutting. For this reason all seed that is to be shipped or which it is not possible to plant at once should be treated.''

Edgerton and Moreland (1920) of Louisiana published a bulletin on effect of fungi on the germination of sugar cane in which they said,—

''*Thielaviopsis paradoxa* occurs very sparingly in Louisiana and as yet does not seem to be responsible for much deterioration.''

Lee (1922) of Hawaii writing of *T. paradoxa* in Philippine Islands says,—

''One of the most serious diseases of sugar cane is the so-called pine-apple disease. The affection is found most commonly in the cuttings, and frequently results in the failure of 50 to 75 per cent of the seeds to germinate. Not infrequently a complete failure results. Plants that do grow from diseased cuttings are generally diseased. In the early stages of infection, diseased cuttings, when split open, are seen to be characterized by a reddening of the tissues, usually in blotches. In advanced cases the red discolored areas turn black with reddish margins and a pineapple odor is given off. Such cases may also have a black mold produced in advanced portions of the infection. Frequently a reddening of the stalk is produced on the cane seed.''

Lee (1922) of Hawaii writing of *T. paradoxa* in Philippine Islands says,—

''Many fields have been observed which had to be entirely replanted or which were entirely abandoned due to lack of germination of the seed caused by this disease. Such loss is in most cases entirely unnecessary.''

Cottrell-Dormer (1925) of Australia wrote,—

''It has been responsible for rather serious damage over an area of one or two acres of heavy black soil. This disease is a very well known one in other countries, and has already been recorded for Queensland. It is a disease of the set and is caused by a fungus which infects tissues of the plant and prevents it from germinating.''

The disease in Puerto Rico attracted the attention of the writer first during the winter of 1927–28 when he received many complaints concerning poor germination. An investigation showed that *Thielaviopsis paradoxa* was the cause of this poor germination and that it was most severe in cold, wet clay soils. No severe outbreaks have been reported since that time. The disease and the fungus causing it have been the subjects of study ever since that date.

Inquiry concernings poor germination in previous years showed that in the opinion of the growers the poor germination was due to poor seed cuttings. The writer is inclined to believe that poor germination in most cases has been due to this fungus combined with unfavorable soil and weather conditions. It is the common practice of the Puerto Rico growers to use seed cuttings with three buds and tests have shown that three bud cuttings are more satisfactory than two or one bud cuttings. This appears to be due to the rapid destruction of short cuttings by this fungi before the young plants can become well established. The dipping of cuttings in Bordeaux mixture which has been practiced to some extent here and in other places has no doubt been advantageous when the cuttings were dipped before they became infected. When the cut surfaces of short seed pieces which are used for experimental purposes are dipped in melted paraffine or tar, the germination was almost or entirely perfect.

The fungus grows readily as a saprophyte, as stated by previous workers. It penetrates wounds of healthy cane and destroys the cell walls of the parenchyma tissue. The first symptoms of the disease is a reddening of the tissues, followed by blackening and a complete breaking down of the parenchyma. In most cases, pure cultures can be obtained from the inner-blackened tissues of these cuttings, showing that the fungus alone is capable of destroying the tissues. Other organisms, especially bacteria, can be obtained near the cut surfaces. The fibro-vascular bundles withstand destruction for a very long time. When the rind is cut through and the cane broken, these bundles can be pulled out in mass like the hairs of a brush.

Field planting at intervals of six or eight weeks have been made over a period of about two years, using both infected and uninfected seed cuttings. Each seed piece had three buds which is in accordance with the planting practice in Porto Rico and were of about the same age. Fifty cuttings of each variety were used in each test. After six or eight weeks the cuttings were lifted, examined and of the number of buds germinating on each piece recorded. These studies show:

(1) *Thielaviopsis paradoxa* is the dominant factor in poor germination in Porto Rico. It lives as a saprophyte on the old canes and is an active wound parasite.

(2) It is most severe during the cooler months of the year. In fact it is rather difficult to get cultures from the lowlands during the summer months and cultures in the laboratory die out. The organism is abundant and vigorous in the higher elevations where the temperature is lower during the summer months.

(3) The destruction of seed cuttings is greatest in the wet, poorly drained soils.

(4) Short seed pieces are usually destroyed more rapidly than long seed pieces of corresponding ages.

(5) The loss of short seed pieces in experimental work and in the propagation of a new variety is sometimes very high. This can be prevented by dipping the freshly cut ends in Bordeaux mixture, paraffine or tar.

(6) The losses from year to year are not equally severe. Sometimes the losses are very high and sometimes very low, depending on local condition, but always higher than the grower believes them to be.

(7) Other fungi and bacteria are more or less common on the decaying cane, but I have no doubt that *Thielaviopsis paradoxa* is the dominant factor in Porto Rico.

(8) *Masamius sacchari* is sometimes quite common; the mycelium forming a net work on the seed pieces and killing some of the buds, but I am unable to say just how important it is.

(9) The fact that *T. paradoxa,* which thrives best during the periods of low temperatures in Porto Rico, is not more destructive in the extreme northern and southern ranges of sugar production, would make temperature studies on the organism in different parts of the world very desirable.

(10) It is very evident that any organism that rots the seed pieces or kills the young buds will reduce the percentage of germination. Also, it is evident that the cut ends of seed pieces are ideal for the penetration of semi-parasitic and rot organisms.

(11) My studies in Porto Rico indicate that *Thielaviopsis paradoxa* is the most important organism in reducing germination. That it is most severe in poorly drained soils and during the cool months of the year. *Marasmius sacchari* attacks and kills buds and young shoots and is probably second in importance.

(12) Comparative studies on causes of poor germination in different parts of the world might gives us some interesting results.

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MARASMIUS SACCHARI; A PARASITE ON SUGAR CANE

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Marasmius sacchari was discovered in Java and described in 1895 by Wakker who believed it to be a parasite on sugar cane and the cause of a disease of the roots. His ideas have been very generally accepted from that time to the present, but some few workers have questioned the parasitism of the organism and its importance as a pathogene. These differences of opinion led the writer to conduct the studies which are recorded in this paper.

The Java growers and their scientific advisers did not believe that this fungus was the lone cause of the troubles they were having at that time and employed Dr. Z. Kamerling to devote all his time to the problem. His studies from 1900 to 1903 resulted in several papers and a book on root diseases of sugar cane. He suggested soil conditions, poor aeration and mechanical injuries are the true causes but his evidence has not been considered as conclusive by the students of the subject.

The second report of the disease was from the West Indies where it was studied by Howard of the Imperial Department of Agriculture from 1899 to 1902. He accepted the work of Wakker but he did not demonstrate the pathogenicity of the fungus. He said,—

"The common root disease of the sugar cane in Barbados is caused by the fungus *Marasmius sacchari* Wakker, the mycelium of which is able, under certain conditions, to overcome the growing point tissues of the developing roots of the cane."

He described the symptoms as follows,—

"Black elliptical areas, surrounded by a reddish border, are also abundant on the leaf-sheaths, which are in some cases slimy to the feel on the inside after a rain, when hard, yellowish, spherical bodies, about the size of a small pea, attached to the outside of the leaf-sheaths by whitish threads are to be seen."

In his discussion he states the sporophores follow the rains and that they dry up quickly; that the mycelium is septate with clamp connections; that the root cap and cortex are invaded by the mycelium and the tissues killed; that the periblem and pleurone are invaded and the growing point destroyed; that the undeveloped roots are marked by brown spots; that new shoots may be killed; that

the vascular bundles may show gumming; and that the pea-like bodies are sclerotia.

He also states that the spore germinate in cane extract in 90 minutes and form stellate colonies; that crystals form at the growing ends of the mycelium in about seven days; that some of the filaments become gelatinous in about 12 days, which probably accounts for the cementing of the sheaths; that rhizomorphs are formed on the sides of the glass containers; that it becomes dormant very readily; and that he demonstrated that the sporophores were developed from the mycelium.

In his discussion of the symptoms, he said that the diseased canes were dwarfed and tended to throw up young shoots; that the dead leaves adhered to the stalk and were cemented together by a white, musty smelling, fungoid growth. The canes could be pulled easily, owing to the destruction of the roots and were very light. The roots do not develop or stop growing very early. The lower leaf bases are difficult to remove. The vascular bundles are reddish in color. As the canes mature, cavities are formed in the internodes and become filled with the mycelium of the fungus.

Cook and Horne (1907) reported a root disease from Cuba which was apparently due to *Marasmius*. The following year, Horne reported *M. sacchari*.

Lewton-Brain (1905) reported a *Marasmius* from Hawaii which he believed to be the same as *M. sacchari* of the West Indies. The following year, Cobb classified this fungus as a variety under the name of *Hawaiiensis*.

In 1909 Cobb wrote as follows:

"Since that bulletin was published other specimens of Marasmius have been found on the island of Oahu that correspond more nearly with the Javanese species, and leave no doubt that we have in Hawaii the same fungus that causes the root-disease of Java and the West Indies, as reported by various observers. It seems possible that the variety Hawaiiensis may have to be raised to the rank of a species, as the differences are even more marked than I had thought from a reading of the descriptions of the species sacchari."

"In the variety Hawaiiensis the young fructificactions were white, while in certain specimens, found later, they are broken. While the upper surface of the pileus in variety Hawaiiensis is smooth, in the specimens here referred to it is radially fibrous, the color being light brown and the fibres hardly projecting sufficiently to produce an actual hairiness."

"These specimens of the true *M. sacchari* are quite as large as the specimens of the variety Hawaiienses described in Bulletin No. 5, and therefore exceed the dimensions given in the original descriptions of the Javanese species."

"They accord more nearly with the size of the specimens of *M. sacchari* found in the West Indies."

In 1908 Fulton reported *Marasmius plicatus* Wakker as being the cause of heavy losses in Louisiana. Some years later Rinking reported this species growing on rotted stems in the Philippine Islands.

Edgerton (1910) writing of the root rot caused by *Marasmius plicatus* says:

"This disease attacks both the cuttings and the growing cane. On the growing cane, it kills the roots and grows in between the lower leaf sheaths. The leaf sheaths are not shed as is the case with healthy cane, but remain glued together around the stalk. If some of these are pulled apart, a network of white mycelium will be seen between them."

"On the cane which is used for seed, this disease will also develop. I have seen it to some extent in nearly every batch of cane which has been sent me this year. The mycelium enters the cut ends of the stalk and grows through them. The disease is readily told by the presence of the white strands of mycelium which may be on or in the stalk. Sometimes the eye is killed before germinating, and sometimes the young plant is killed after germination."

Johnson and Stevenson (1917) published a paper on sugar cane fungi and diseases in Puerto Rico in which they record *Marasmius sacchari* Wakker, *Himantia stellifera* Johnston, *Odontia saccharicola* Burt and *O. sacchari* Burt growing at the base of cane stalks and apparently attacking the roots.

They say:

"The exact status of root diseases with respect to the parasitism of *Marasmius*, *Himantia*, *Odontia* and possibly other forms is uncertain, and while it is generally held that *Marasmius* at least is a true parasite, really definite evidence is lacking. Studies under control conditions must be carried out working with pure cultures of the fungi which has not yet been possible."

In their discussion of *Marasmius sacchari*, they said,—

"The injury caused is primarily upon the roots. The mycelium enters the roots, disintegrates the tissues and prevents a proper absorption of water and nutriment from the soil. As a result of this injury to the roots there is the secondary effect upon the development of the plant. According as the attack is severe or mild, the host shows a varying amount of leaf curling, a dwarfing of the stool, and often an early succumbing to less vigorous parasites such as *Melanconium*.

"Injury to the roots can be ascertained by direct examination, a slow tedious process, or to a certain extent can be diagnosed by symptoms above ground. The fungus itself eventually appears on the cane above ground, growing within and upon the lower leaf-sheaths, sometimes one-half or two-thirds the height of the stalk. The external appearance is a white mycelial growth, which is conspicuous by its rather smooth membranous appearance in contrast to a distinct filamentous growth. Tearing away the affected leaf-sheaths reveals the fact that they are decayed, and are glued together as it were by the membranous growth, to the underlying sheaths and the stalk. The decay of the lower sheaths may or may not in itself be of great importance, but the binding of the leaf-sheath to

the stem is very undesirable from the view point of the mill worker who prefers clean cane."

"This fungus, like some others, appears to make great headway when once it has attained a strong foothold on the host. Thus the fungus may develop well on plant cane without doing appreciable injury, but may increase its foothold on the ratoons so as to do double the injury. As a result of this action it is a common sequence that plant crops are fair in certain localities, the first ratoon is considerably poorer, and the second ratoon often dies out completely. The damage may be restricted to one or a few stalks on a stool, or more commonly it may affect an entire as well as one or more adjacent stools to form the characteristic spots, or more rarely large portions of the field are entirely affected."

"The injury to the plant may be considered threefold: the growth of the plant is checked often to the point where no merchantable cane is produced, the matter of clean cane is rendered difficult, and the cane becomes more susceptible to other diseases."

The geographical distribution of *M. sacchari* and related species may be summarized as follows,—*M. sacchari* has been reported from Java, India, Australia, Formosa, Hawaii, Porto Rico, Jamaica, Lesser Antilles, British Guiana and South Africa. *M. plicatus* from Java, Philippines and United States; *M. stenophyllus* from Santo Domingo and Lesser Antilles; *Marasmius* sp. from Fiji, Central America and Brazil; and *Hypochnus sacchari* from Cuba and Jamaica.

Matz, Earle and some others did not believe that *M. sacchari* was an important parasite. In 1920 Earle said:

"*Marasmius* is at best a very feeble parasite. It may over-run new healthy roots or other organs without killing them."

After a discussion of *Rhizoctonia* and *Pythium* he says:

"Nothing could be more convincing than that these heretofore unsuspected species and not *Marasmius* and its allies are the true root-killing agents."

Matz (1920) said:

"It was noticed that in the *Marasmius* pots, although the white threads of the fungus had penetrated through the upper three or four inches of soil, the growing roots of the cane seed were not affected in any unusual way. Mycelium was observed on some roots but no rotting took place. However, after three months from inoculation there could not be seen any appreciable difference in the growth between any of the inoculated plants and those used as checks."
* * * "Four months from inoculation the pots inoculated with *Marasmius* produced the fruiting stage of the fungus at the same time the cane plants were among the tallest and most vigorous ones."

When the inoculated plants were removed from the soil, Matz states that—

"in the case of *Marasmius*, although the fungus mycelium was plainly visible in amongst the soil particles, yet the roots did not show as much decay as in

the first two (i. e. *Rhizoctonia* and *Pythium*). * * * The roots of the check plants were normal.''

In speaking of another experiment he says:

''Although the fungus mycelium of *Marasmius* was in contact with the roots there were no signs of decay in them.''

Van der Bijl (1921) of South Africa says:

''A soil fungus common in cane fields is *Himantia stellifera*, 'the stellate crystal fungus'. This fungus is evident at the base of the cane, cementing the basal leaves together, and when the cane stool is opened interwoven white threads of the fungus are also seen in the ground between the cane roots.''

''In smothering the young buds the fungus lessens the stand in ratoon crops, and it has also been observed to prevent the growth of planted cuttings.''

''It is responsible for killing the rootlets, of the cane, and it thus weakens the plants and makes them more liable to attacks by other fungi; and with a diminished root system the plants are in periods of drought not in the best position to obtain from the soil the water it still contains. Plants having their roots attacked by this fungus invariably suffer more from the effects of drought.''

''Under the microscope this fungus is easily distinguished from all others by the stellate crystals which are borne on branches of the vegetative threads of the fungus. These crystals have given the fungus the popular name of 'Stellate Crystal Fungus'.''

''In addition to cane, the fungus has been observed on the 'umthente' grass *(Imperata arundinacea)*, and it probably occurs and vegetates on other grasses as well.''

''On cane the fungus is of the nature of a weak parasite and control methods should aim at thorough cultivation to ensure a vigorous growth of cane, conservation of soil moisture, and aeration of the root system.''

In 1921 there was a severe outbreak of root rot on EK 28 in Java, which was studied by Dr. J. Kuyper. In his opinion this disease was not due to a parasite but to soil conditions and to stagnant water in the soil.

Matz (1921) of Porto Rico described and discussed the relationship of several species of *Rhizoctonia* to root rots and Bourne of Barbados gave proof of the pathogenicity of *R. solani* and *R. palida*. Bourne said:

''The writer has confirmed the observations made by Matz relative to the absence of the fungus *Marasmius sacchari*, Wakker, binding the basal leaf sheaths to the stalk in otherwise typical cases of root disease. Indeed, in some instances other common saprophytic fungi, e. g., *Trichoderma lignonum* were present to the exclusion of *Marasmius*. Thus it is evident that in Barbados as in Porto Rico the presence of either one or both of these latter fungi commonly associated with decaying leaf sheaths and cane bases is of no significance whatever and may or may not be associated with typical cases of root disease, depending on whether they happen to form part of the fungus flora of the soil giving rise to root diseased plants. Some plants are so seriously attacked that they are only about

one-half the size of those in their immediate vicinity which apparently have not yet contracted the disease but which did so a few weeks afterwards. The yellowish unhealthy appearance of the leaves of these attacked stools was very significant when a comparison was made with those plants which were not yet suffering from the disease although growing in the same field quite close to the former."

"*Marasmius sacchari* has never been isolated from freshly diseased and dying cane roots but only from dead ones."

Nowell in his Diseases of Crop Plants in the Lesser Antiller (published about 1922 or 1923) says:

"Instances have on several distinct occasions come under the observation of the writer in young plant canes in Barbados, and recently in fields of first ratoons in Trinidad, in which plants growing in good well-tilled soil and previously healthy and vigorous have rapidly failed, and have been found to be heavily infested with *Marasmius*, not only on the roots and leaf-sheaths, but in the tissues of the basal joints of the cane. In such cases the fructificactions of the fungus have been produced with unusual readiness and in considerable quantity."

"The attacks on plant canes have occurred in somewhat scattered stools during the dry season. On one occasion numbers of stools Ba. 6032 were quite killed out in this way, while plants of B–6450, in the same field, which were not nearly so forward, were unaffected. The basal joints, and the sprouting buds in all stages were internally reddened and filled with *Marasmius* mycelium. This type of disease agrees with the effects of *Marasmius sacchari* as first described by Wakker in Java, where the ordinary West Indian type, presumably owing to the scarcity of ratoons, does not seem to be familiar. In Barbados *M. sacchari* was the species met with in the cases described."

"The most striking instance seen in Trinidad was in a field of Hill's Seedlings 6 to 12, unusually well-grown first ratoons in deep and fairly heavy loam, sufficiently drained. Very many of the large canes were badly infested or completely rotted for several joints at the base, the parts above remaining sound until dried up by the cutting off of their supply of water. The young leafy shoots were also dying upwards owing to infestation in their base. The stools were exceedingly loose in the soil, and many were turned out by the weight of their own canes. An unidentified species of *Marasmius*, with bluish black stalks, was fruiting abundantly from the roots, the root 'eyes' on the stem, and the young shoots. Other fungi were not conspicuous."

"While no proof can be offered, the cases described, and others similar, present the appearance of active parasitism by *Marasmius* species. The Barbados examples were attributed to the weakening of resistance by drought, and stools not completely killed recovered after rain. The sudden failure of the Trinidad field described could only be attributed to the effect of a second dressing of sulphate of ammonia on a soil already almost depleted of its small supply of lime."

Lyon (1923) of Hawaii published a paper in which he said,—

"An intensive study of root-rot in the field and laboratory conducted by Larsen and Lyon served to demonstrate that *Ithyphallus* * and *Marasmius* had no

* This fungus was reported as the cause of a root-rot in 1906, but further studies have failed to prove its pathogenicity.

primary connection with epidemic root-rot in Hawaii and that other fungi were responsible for the destruction of the cane roots. These fungi were taken up in turn but each failed to qualify under test as the primary cause of root-rot. Finally by transferring diseased cane stools from diseased to healthy fields, it was demonstrated that these fungi could not materially check the growth of the cane plant if the soil conditions were right. Evidence deduced from extensive field studies and many experiments performed seem to prove that the cause of root-rot in Hawaii was some non-parasitic factor resident in the soil and to indicate that this factor was in the nature of a poison."

"It is a fact recognized by all pathologists that the ultimate destruction of the tissues of the root system is brought about through the action of organisms dwelling in the soil. This is, of course, the fate of all roots that die from any cause whatsoever, so the decay of roots induced by organisms does not, by any means, prove that the death of the roots was due to these organisms. Among the organisms found in cane roots in areas where root-rot is prevalent are several forms with pronounced parasitic abilities. They are capable of attacking, and do attack, live cane roots, bringing about the destruction of the latter. The only question is: can they, unaided, destroy the roots rapidly enough to produce root-rot in cane? Some pathologists say that they can, while others say that they cannot unless the vitality and resistance of the cane is first reduced or broken down by some non-parasitic factor in the soil. We are, therefore, confronted with two opinions regarding the primary cause of root-rot and we may profitably consider each in turn as correct and see what course should be followed under the circumstances."

Earle in 1927 referred to the work of Matz on *Rhizoctonia* and *Pythium* and said:

"He also showed that pure cultures of *Marasmius* had not such effect, but that the cane roots continued sound even when envolved in masses of conspicuous white mycelium. * * * No evidence has been adduced to show that either *Marasmius* or the other hymenomycetes found on cane roots are ever parasites. They may interfere somewhat with normal growth but they do not kill roots."

He also said,—

"A considerable number of contributory causes of root disease have already been indicated. Doubtless the list could be extended, but the fact would remain that the great majority of cases are caused by a bad physical condition of the soil, resulting in lack of aeration for the roots. Like all living things, the cane roots must have oxygen in order to function properly. If the soil is unduly compacted or heavily crusted the supply is interfered with. If the soil becomes waterlogged for even a few days, trouble is almost certain, for cane is not an aquatic plant and its roots cannot take their oxygen supply from water. Probably lack of drainage is responsible for more cases of root disease than all other factors combined. Standing water for even a few days is almost certain to weaken the roots. The effects will probably not be observed until the first sharp drouths, when the rolling of the leaves and other symptoms of root disease will appear in all those spots where there has been standing water. Obviously such cases could be avoided by proper drainage, especially if accompanied by prompt tillage as soon as possible after heavy rains to break up surface crusting and to so open up the compacted soil as to permit air to enter freely."

Faris and Allison (1927) said,—

"The field studies show root disease to be associated with lack of aeration in undrained soils, with high salt content of the soil, with drouth and resultant cracking of the soil, with high cutting and surface application of fertilizers, with infertile soils, and with the attacks on the roots of several * * * insects and other small animals."

In 1929 Bell published A Key for the Field Identification of Sugar Cane in which he gives the following discussion:

"Root-rots of the *Marasmius* type are those caused by weak parasites which are only capable of entering and parasitising the roots after the latter have been weakened by unfavorable soil conditions or damaged by the small animal life inhabiting the soil. These rots are characterized by the fact that they affect the cortex only, and the fungi are apparently unable to penetrate the endodermis and destroy the stele or conducting tissue. The roots consequently retain their rigidity and do not become flaccid as happens in the pythium type of rot, where the stele is destroyed. A fungous rotting of the cortex of the older portions of the roots is accepted as a normal process and probably does little or no harm. When the plant is weakened these fungi are enabled to enter the cortex of the young roots, causing a brownish-red, and destroying the growing tips of the primary and secondary roots. Abnormal branching of the roots follows and the tips of these branches are in turn killed, and as a result of the greatly reduced root system diseased stools are often very easily uprooted from the soil. Such fungi are often associated with a cementing of the lower leaf sheaths, a common occurrence in the rot caused by *Marasmius sacchari*, when the leaf sheaths are bound together by a white mycelium. In the later stages of the rot caused by *Marasmius sacchari* it is often possible to find the small mush-room-like fruiting bodies at the base of the diseased stools."

Carpenter (1932) of Hawaii presented a paper to the International Society of Sugar Cane Technologists in which he said.—

"Growth failure of cane in Hawaii embraces a division of the diseases coming within the category of root disturbances into two main forms: (1) Miscellaneous failures fundamentally nutritional in nature, caused by faulty soil conditions in restricted areas, (2) root disease caused by *Pythium aphanidermatum* accelerated by excessive amounts of nitrogenous nutrients for the particular variety."

* * * * * * *

"Emphasis in our growth-failure investigations has gradually shifted from studies of the parasitic root diseases which have now been clarified, to consideration of the soil conditions at fault in the localized areas where cane does not grow normally. The great majority of persistent growth-failure areas appear to be naturally poor soils where cane has never grown well."

During the past few years the writer's attention was called very frequently to plants which were making poor growth: The lower leaves were dead and bound together and to the base of the plant with a weft of white mycelium which extended both above and below ground. Young canes were sometimes killed but it was impossible to

say that they had been killed by this fungus. The roots were very generally in bad condition but it was impossible to say that it was due to the fungus. The symptoms, character of the fungus and the presence of occasional sporophores indicated that we were dealing with *Marasmius sacchari* but it was evident that no definite statement could be made from field observations only.

Laboratory studies proved that the fungus could be isolated very easily and that it grew well in culture, especially on pieces of cane that had been sterilized in the autoclave, but some difficulty was experienced in growing it on living cane. This was overcome by growing sterilized cuttings in glass cylinders and inoculating with the fungus grown on sterilized cane plugs as follows:

(1) A small amount of water was put in the bottoms of glass cylinders which were about 15 inches in height and sterilized in the autoclave. (2) Pieces of cane about two inches in length and bearing one bud were sterilized in 1 to 1000 corrosive sublimate solution, dipped in sterilized water and then dropped into these tubes. (3) The fungus was isolated and grown first on agar and then on plugs of sterilized cane in test or culture tubes. (4) A reasonable time was allowed to make sure that the cuttings were sterile and that the fungus was making a good growth on the plugs. (5) The inoculated plugs were then dropped into the tall tubes at intervals so that young plants of various ages might become infected. Sometimes the plug was placed in contact with the cuttings and at other times in contact with the young shoot.

The fungus grew rapidly, spreading over the surface of all parts of the cutting except the part which was submerged in the water. It also covered the roots above the water but not those that were below the surface. It attacked any part of the young shoot with which it cane in contact, gradually penetrating and completely covering the smaller ones. Buds that were covered early never germinated. Young shoots were killed more quickly than the older shoots.

Young cane plants were grown in sterilized soil and inoculated by pushing infected cane plugs down into the soil beside them. The growth of these plants was dwarfed but none of them killed.

Large plants grown in unsterilized soil in the green house were cut and infected plugs were pushed into the soil beside them. Some of these plants did not grow well but it was impossible to say definitely that the fungus was the cause of the poor growth.

HISTOLOGY

When small amounts of agar containing mycelium were placed in contact with the young canes growing in glass cylinders, the results were negative in most cases, probably because of the rapid drying of the agar. When plugs of sugar cane, which had been inoculated with the fungus were placed in contact with young canes growing under the same conditions, the mycelium spread over the surface of the cane very rapidly and caused a darkening and a killing of the tissues and eventually a killing of the plant. Micro-preparations were made from these infected plants and the story is told in figures 1 to 5. The fungus formed a mass of mycelium over the surface and between the leaves (Fig. 3). It penetrates the cells of these young plants very readily and could be found in all cells except those with very thick, hard walls such as are found in the fibro-vascular bundles. In case the inoculated plugs are brought into contact with the tip of the young cane the mycelium may penetrate the young part of the fibro-vascular bundles.

Sections were made of infected roots and the fungus found in all parts, although less abundant in the cells of the fibro-vascular bundles (Fig. 1).

DISCUSSION

The studies recorded in this paper indicate that *Marasmius sacchari* is a very common and widely distributed saprophyte which grows abundantly on dead fragments of cane and that under favorable conditions it may become an important parasite.

It attacks leaves, stems and roots and there is no more reason for calling it a root parasite than for calling it a leaf or stem parasite. It attacks young canes and kills considerable numbers of them. I am unable to say just how important it is or just what conditions are most favorable for its growth. When the growth of the cane is retarded it may come in as a secondary factor and do much damage to the crop. It is a common parasite on old and dying cane.

It attack seed cuttings, covering them with a weft of mycelium, killing the buds and causing them to rot, but the decay is not so rapid as that cause by *Thielaviopsis paradoxa.*

The symptoms are quite definite but some of them may be due to other causes. The binding of the leaves at the base of the cane is one of the most distinctive characters on growing cane. Young canes may be killed and completely covered with mycelium. Seed pieces may be completely covered with mycelium and the buds killed. The presence of the fungus on cane does not necessarily indicate that it

is the cause of retarded growth or the death of the cane. The cane may be weak or have died from other causes and *M. sacchari* may be secondary. The writer has never found sporophores or any other than dead canes.

The parasitism of the fungus cannot be doubted. The writer has demonstrated that the mycelium will penetrate the tissues readily and kill growing cane.

The environmental factors are very important and there is much truth in statement of Kuyper, Earle, Lyon and Carpenter concerning soil and water but none of these workers have demonstrated that the fungus is not a parasite. The fungus can nearly always be found on cane that has made a poor growth as a result of soil and water conditions that are unfavorable for the growth of the cane and it can be found also on cane that has been injured or retarded by other fungi.

The writer has found many dead shoots in fields which were evidently killed by this fungus although most of the cane was making an excellent growth. Poor drainage is an extremely important factor, especially in the killing of the buds on seed pieces.

In general it is of minor importance but the losses are sometimes greater than are attributed to it by most growers. Good soil, proper use of fertilizer, good preparation before planting, good drainage and good cultivation are most important factors in the control of this fungus.

SUMMARY

1. The fungus is a vigorous saprophyte, which can be found in abundance on fragments of cane and cane leaves in and on the surface of the soil. Also on the old dead leaves of growing canes.

2. The mycelium frequently cements the leaves and checks the growth of the canes, but its presence does not necessarily indicate that it is the cause of the retarded growth or the death of the cane.

3. The fungus is a parasite and penetrates roots, leaves and stalks of young canes very readily.

4. It kills a small percentage of young canes and sometimes injures older canes. These losses depend on soil and climatic conditions and vary with the seasons. They are probably less than some reports indicate and greater than is indicated by others.

5. The fungus sometimes attacks seed cuttings and kills the buds. The writer has one record of a killing of 20 per cent.

6. The writer has not observed the pea-like bodies which Howard described as sclerotia but has observed the large sclerotia formed by

Rhizoctocnia grisea which was described several years earlier as *Sclerotium griseum* Stevenson.

7. The writer has demonstrated that the fungus will grow from old material or from a pure culture and penetrate the living tissues of canes growing in glass cylinders or in sterilized soil in pots.

8. The fungus penetrates the canes, leaves and roots and will kill many of them when the conditions are favorable.

9. A considerable amount of the fungus either in or outside the cane appears to be necessary for the production of sporophores.

10. Sporophores were produced in my cultures, on cane grown in cylinders, in from two to four months after inoculation.

Explanation of Plates

PLATE XIX

A young shoot killed by *Marasmius sacchari* in the field.

PLATE XX

Two shoots grown in glass cylinders. The one on the right shows the first mature sporophore grown by this method.

PLATE XXI

right shows the first mature sporophore grown by this method.

Left; cane grown in ordinary field soil.

Right; cane grown in soil of the same kind that had been sterilized and then inoculated with *Marasmius sacchari* by pushing infected pieces of cane in the soil.

PLATE XXII

Seed cutting covered with *Marasmius sacchari.* One bud killed. Two shoots heavily infected with the fungus.

PLATE XXIII

Figure 1. Cross section of root from surface to center showing mycelium in the cells; also (*a*) mycelium on surface, c marks the center of the root.

Figure 2. Cross section of young leaf showing mycelium in the cells, a, upper epidermis.

Figure 3. Cross section of older leaf showing mycelium in cells and on surface a.

Figure 4. Large parenchyma cells containing mycelium.

Figure 5. Parenchyma cells next to fibro-vascular bundles, showing mycelium in cells.

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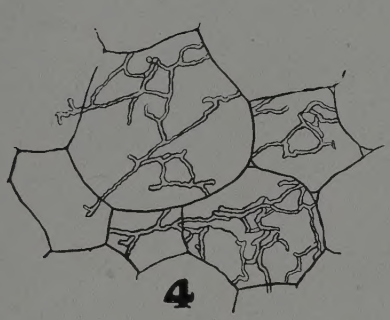
PLATE XIX

PLATE XX

PLATE XXI

PLATE XXII

PLATE XXIII



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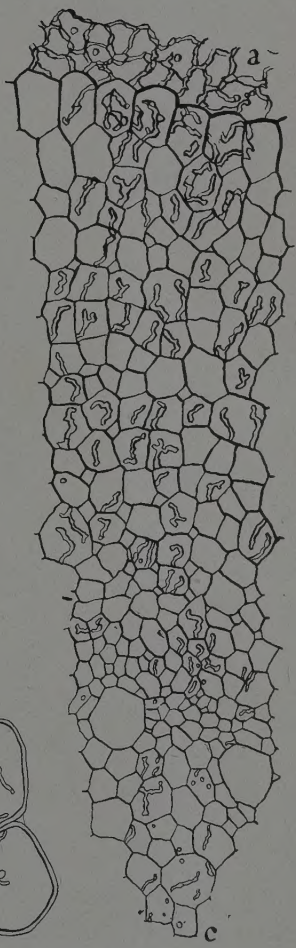

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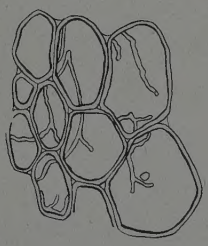

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